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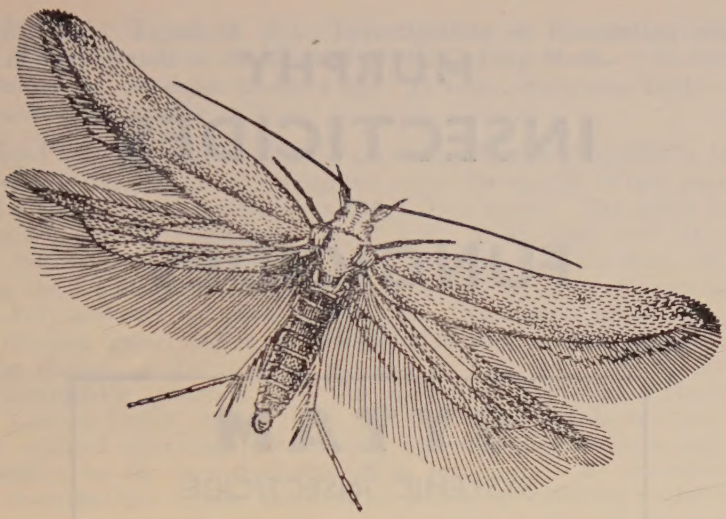

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[Tadić (M. D.).] Тадић(М. Д.). **Investigations in Connection with the Use of Trap Bands in the Control of the Codling Moth.** [*In Serbian.*] —*Plant Prot.* no. 3 pp. 13–30, 4 figs., 11 refs. Belgrade, 1951. (With a Summary in English.)

A detailed account is given of field experiments near Belgrade in 1949–50 on the value of trap bands of corrugated paper for control of first-generation larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple. The moth has two generations a year in Yugoslavia [*cf. R.A.E.*, A **41** 104], and the bands, some of which were impregnated with β-naphthol in machine oil, were placed on the trunks of the trees at a height of 3–4½ ft. on various dates in June or July and left for about a fortnight. Numerous larvae were found to have entered them, and it is recommended that non-impregnated bands should be placed on the trees at the end of June and replaced by fresh ones at fortnightly intervals until the beginning of August. There is no need to remove bands treated with β-naphthol, as the larvae that enter them die without spinning their cocoons, but they should not be left in the same position on the tree for longer than two years. A concentration of 7½ lb. β-naphthol per 2 gals. machine oil proved as effective as 10 lb., and alcohol and kerosene were not satisfactory substitutes for the oil as solvents for the β-naphthol. Various preparations of DDT tested instead of β-naphthol were also unsatisfactory. Contrary to the findings of other workers, no injury to young trees with smooth bark resulted from the application of the impregnated bands directly to the trunk, but to protect susceptible trees from possible injury by β-naphthol, the use of ordinary wrapping paper under the treated bands is recommended. If an untreated band of corrugated paper was applied under the impregnated band, many of the larvae survived under the former. Not all the larvae sought pupation sites in the bands, however, many doing so on other parts of the trunks, off the trees altogether or even in the soil, so that the use of trap bands can be regarded only as an auxiliary measure to be included in a general programme of control.

[Ilić (B.) & Stanković (A.).] Илић (Б.) и Станковић (А.). **The Mass Appearance of *Zabrus tenebrioides* in Voivodina in 1949.** [*In Serbian.*] —*Plant Prot.* no. 3 pp. 57–61. Belgrade, 1951. (With a Summary in French.)

In late April and early May 1949, winter wheat and barley in several districts in northern Yugoslavia were almost completely destroyed by larvae of *Zabrus tenebrioides* (Goeze), large numbers of which were present in the soil. Investigations showed that attack was heaviest in fields in which winter oats or barley mixed with leguminous crops, mainly winter vetch [*Vicia*] grown for seed, had been grown in the preceding year [*cf. R.A.E.*, A **33** 11]. When the vetch was harvested, the oats and barley were over-ripe and most of the grain had fallen to the ground and sprouted. This attracted the ovipositing females, and the resulting larvae developed on the self-sown plants and later attacked the winter crops.

Nonveiller (G.). **Dudovac nova štetočina za Jugoslaviju.** [*Hyphantria cunea* Drury, a new Pest in Yugoslavia.]—*Plant Prot.* no. 3 pp. 87–95, 3 figs., 1 map, 7 refs. Belgrade, 1951. (With a Summary in French.)

The history of the appearance and spread of *Hyphantria cunea* (Dru.) in Hungary is briefly reviewed [*cf. R.A.E.*, A **38** 162, etc.] and it is stated

that the moth was first observed in Yugoslavia in 1948. It was then present near Subotica, close to the Hungarian frontier. It spread southwards in 1949, causing serious damage to many trees, particularly to mulberry, and had reached the Danube by the end of 1950. The moth has two and possibly three generations a year in Yugoslavia. Adults from the over-wintered pupae appear in May and survive for a few days only. The females usually deposit the whole of their eggs in one batch, and up to 1,100 eggs per batch were observed [*cf.* **41** 61]. The larvae hatch in about a week and skeletonise the leaves, webbing them together to form nests. Older larvae abandon the nests and feed openly on the same or neighbouring branches. They give rise to adults at the end of June, and eggs and adults of the second generation occur at the beginning of July and the end of August, respectively. Almost full-fed larvae of a third generation were observed at the end of October. The economic importance of *H. cunea* is discussed, and the control measures recommended in Hungary [**38** 162] are reviewed. Parasitism of the larvae and pupae was high in some cases, but the parasites were not identified.

Turner (N.), Saunders (D. H.) & Willaman (J. J.). **The Effect of some Polyethyleneglycol Derivatives on the Toxicity of Nicotine to Insects.** —*Bull. Conn. agric. Exp. Sta.* no. 543, 35 pp., 9 graphs, 27 refs. New Haven, Conn., 1951.

The following is largely based on the authors' summary of this account of laboratory investigations in Connecticut in 1948–49 on the effect of polyethyleneglycol derivatives on the penetration of insect cuticle by nicotine. The experimental materials were in general used at a concentration of 0·5 per cent. and were applied, with or without alkaloid nicotine or nicotine sulphate at 0·04 per cent. nicotine, as sprays to *Aphis fabae* Scop. (*rumicis*, auct.) on nasturtium [*Tropaeolum majus*] or by injection into *Oncopeltus fasciatus* (Dall.). In preliminary spray tests with one non-ionic and several ionic wetting agents at 0·1 per cent. in combination with alkaloid nicotine or nicotine sulphate, made to determine differences due to the two types of nicotine, sodium oleate and a proprietary ammonium soap both increased toxicity, the former having the greater effect on nicotine sulphate and the latter on alkaloid nicotine, ammonium linoleate did not affect nicotine sulphate and decreased the toxicity of alkaloid nicotine, and a proprietary cationic quaternary ammonium compound (Ammonyx Q) and a proprietary non-ionic wetting agent (Igepal 300) had little effect on either.

Of 30 non-ionic polyethyleneglycol derivatives tested with nicotine sulphate in sprays, 19 increased toxicity, five reduced it and six had little effect. When 17 of the most effective were used at concentrations of 0·0625, 0·125, 0·25 and 0·5 per cent., the higher concentrations were in general the most effective. Polyethyleneglycol-1000 monooleate, polyethyleneglycol-400 monolaurate, polyethyleneglycol-600 monolaurate, polyethyleneglycol-400 monooleate, and octaethyleneglycol monododecyl ether all increased toxicity by tenfold or more, which is considered sufficient to be of practical value, and the two monolaurates appeared to be the best, since they also steepened the dosage-response curve; five of the less effective materials also steepened the curve. A spray test with six of the materials used at a concentration of 4 per cent. with and without nicotine sulphate showed that all were toxic to the Aphid, and that they exerted significant synergism with nicotine. When applied alone at a concentration of 4 per cent. by injection, only four of the compounds were toxic to *O. fasciatus*, and none of the five that gave the maximum increase in the toxicity of nicotine in the sprays were among these. None of 15 compounds, including some effective in sprays, increased

the toxicity of alkaloid nicotine when applied by injection. It seems evident that the synergism demonstrated in the spray tests was the result of improved penetration of the cuticle. Earlier findings indicated that alkalis increase the toxicity of nicotine in sprays [*R.A.E.*, A **12** 80], but in tests of the effect of alkaline and ionic materials on its toxicity by injection, sodium oleate and the ammonium soap did not affect the toxicity of either the sulphate or the alkaloid, and sodium hydroxide and the non-ionic Triton X-100 (decaethyleneglycol mono-p-(1,1,3,3,-tetramethylbutyl)phenyl ether) did not affect nicotine sulphate and flattened the dosage-response curve for alkaloid nicotine, though a correction for the toxicity of the former was necessary.

Only the monolaurate and monooleate compounds were used in series sufficiently long for comparison between chemical constitution and effectiveness. The effectiveness of the monooleates in sprays with nicotine sulphate first increased and then decreased as the length of the ethyleneglycol chain increased; that of the monolaurates increased consistently with increase in chain-length.

Hough (W. S.) & Mason (A. F.). **Spraying, Dusting and Fumigating of Plants. Principles and Applications.**—2nd revd. edn., 8½ × 5½ ins., ix + 726 pp., 241 figs., refs. New York, N.Y., Macmillan Co., 1951. Price $12.50.

This second edition of a book on crop protection in the United States and Canada follows the same general plan as the first [*R.A.E.*, A **16** 431], which has been considerably extended and almost entirely rewritten. The first part comprises 11 chapters dealing with materials and equipment for the control of pests and the principles underlying their use. It includes an introductory account of the development of pest control, information on the uses, properties, specifications, mode of action, preparation and formulations of materials used against insects and mites and of auxiliary spray materials, descriptions of spraying and dusting apparatus with information on performance and function and on the practice of spraying and dusting, and techniques for fumigation, the application of seed dressings and soil sterilisation. The second part contains brief descriptions of the appearance and habits and recommendations for the control of numerous insects, mites and fungi that attack fruits, vegetables, cotton and tobacco and of insects of general importance, preceded in many cases by a key for the diagnosis of the different types of injury to which the crop concerned is susceptible; instructions for the preparation and use of poison baits are included.

Keen (F. P.). **Insect Enemies of western Forests.**—*Misc. Publ. U.S. Dep. Agric.* no. 273 (revd.), 280 pp., 111 figs., 163 refs. Washington, D.C., 1952. Price $1.

This bulletin resembles the earlier edition [*R.A.E.*, A **26** 400] in arrangement and scope, but it has been partly rewritten to bring the information, notably that on control by means of insecticides, up to date. Some additional insects are included, and a few previously dealt with are omitted.

Duffy (E. A. J.). **A Monograph of the immature Stages of British and imported Timber Beetles (Cerambycidae).**—10 × 7¼ ins., viii + 350 pp., frontis., 8 pls., 292 figs., 25 pp. refs. London, Brit. Mus. (Nat. Hist.), 1953. Price £4 4*s*.

This work on the Longicorns indigenous in or imported into Britain is based on a comprehensive study of the literature published up to 1948 and

original observations. General accounts are given of the importance of Longicorns as pests of timber or living trees and their bionomics, followed by sections on the general morphology of the larvae and the characters of the pupae, including keys to the larvae of 110 species and the pupae of 76. Of these, 64 are British and the remainder have been found in timber imported into Britain. The next and largest section comprises a systematic list of some 200 species, with indications as to whether they are indigenous, descriptions of the eggs, larvae and pupae so far as known, lists of the timbers or living plants attacked and of natural enemies, summaries of the available information on their bionomics and control, references to the literature and records of the material studied. The concluding section contains instructions for collecting, rearing, preserving and storing the immature stages.

Wallace (T.) & Marsh (R. W.). Ed. **Science and Fruit. Commemorating the Jubilee of the Long Ashton Research Station 1903–1953.**—10 × 6¼ ins., xiii + 308 pp., frontis., 32 pls., 21 figs., refs. Bristol, Univ. Bristol, 1953. Price £1 10*s*.

This book commemorating the fiftieth anniversary of the founding of the Long Ashton Research Station comprises a symposium of papers by past and present members of the Staff dealing with various aspects of the work on the production and use of fruit crops carried on at the Station, which together show the development of research over the past 50 years. The subjects of special interest in economic entomology are the control of insect pests of apple in Britain, the development of insecticides and fungicides and of spraying methods and equipment, the chemical standardisation of insecticides and fungicides, and the insecticidal activity of DDT, DDT analogues and other related compounds.

European Plant Protection Organisation. **Colorado Beetle in Europe in 1952.** [*In English & French.*]—28 pp., 4 figs., 5 maps, 1 ref. Paris, 1953.

The distribution of *Leptinotarsa decemlineata* (Say) on potato in Europe in 1952, based on reports from countries that are members or correspondents of the European Plant Protection Organisation, is shown on maps and reviewed for the various countries concerned grouped in four geographical regions, and notes are given for each on weather, bionomics, damage and control. The countries in which infestation was general were France, Holland, Belgium, Luxembourg, Federal Germany, the Territory of Trieste and Spain. Much of Portugal, Switzerland and Austria and parts of northern and central Italy and the extreme north of Yugoslavia were also infested.

Gasser (R.). **Über zwei neue Akarizide aus der Gruppe der Di-(*p*-chlorphenyl)-karbinole.** [On two new Acaricides of the Bis(p-chlorophenyl)-carbinol Group.]—*Experientia* **8** pt. 2 p. 65, repr. 5 pp., 8 refs. Basle, 1952. (With a Summary in English.)

In the course of investigations in Switzerland on DDT analogues, bis(p-chlorophenyl)-ethoxy-methylcarbinol and the ethyl ester of 4,4′-dichlorobenzilic acid, referred to as G23645 and G23992, respectively, both showed outstanding acaricidal properties [*cf. R.A.E.*, A **40** 238]. The first is a

white crystalline substance that melts at 58–59°C. [136·4–138·2°F.] and boils at 155–157°C. [311–314·6°F.]. The median lethal dose *per os* for rats and mice exceeded 5,000 mg. per kg. body weight. The second is a yellowish oily substance that boils at 141–142°C. [285·8–287·6°F.], and the median lethal doses for rats and mice were 3,100 and 4,850 mg. per kg., respectively. Both were readily soluble in the usual organic solvents. Emulsified solutions containing 0·01–0·1 per cent. of either applied directly to *Tetranychus telarius* (L.) (*urticae* Koch) on bean plants in the laboratory caused complete or almost complete mortality of all stages, including the eggs, after six days. The toxicity of deposits up to ten days old was tested by placing female mites on leaves previously treated with emulsified solutions containing 0·02 or 0·05 per cent. of the chemicals. The two materials were about equal in effectiveness and rather superior, particularly at the lower concentration, to 1,1-bis(p-chlorophenyl)ethanol (Dimite), with which they were compared. The results obtained in the laboratory were confirmed in field tests against *T. telarius* and *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.) in 1951. Both materials were toxic by contact and had no fumigant or systemic effect, and neither showed any appreciable insecticidal or fungicidal action.

Roberti (D.). **La lida del pino** (*Acantholyda nemoralis* **Thomson**). [The Pine Sawfly (*A. pinivora* Ensl.).]—*Boll. Lab. Ent. agr. Portici* **10** pp. 25–85, 24 figs., 35 refs. Portici, 1951. (With a Summary in English.)

The author reviews the distribution of *Acantholyda pinivora* Ensl. (*nemoralis* (Thoms.)), describes all stages of this sawfly and gives an account of observations in 1948–49 on its bionomics and control near Aquila, in central Italy, where it has caused increasing damage in the last ten years to plantations of pine established about 1900. Both *Pinus nigra*, the main species present, and *P. sylvestris*, which is rare, are attacked. The adults emerged in late April and were present throughout May, disappearing by mid-June. At the time of maximum emergence not more than 5 per cent. of the adults were females, and this proportion increased only slightly as emergence continued. This preponderance of males was confirmed by examination of full-fed larvae in the soil, not more than 10–18 per cent. of which were females. Pairing took place shortly after emergence, and the females inserted their eggs into the needles of the previous year, usually one to each needle, but sometimes 3–4 when infestation was heavy. Dissected females contained 14–28 eggs each. The larvae hatched in 10–15 days and fed on the young needles, moving from one to another. Old needles were sometimes attacked by older individuals. The larvae became fully fed in 16–19 days and entered the soil in June, where they overwintered. In mild areas, some larvae pupated in the following spring, but others, especially in more exposed places, remained in diapause for a further year. The damage caused varies with the degree of infestation and the condition of the tree, but even well developed trees are sometimes killed by severe attack in successive years. The variety of *P. nigra* chiefly grown near Aquila appeared fairly resistant to prolonged defoliation. The only parasite found was an unidentified Tachinid that emerged from one of numerous larvae collected from the soil.

In the tests on control, a BHC dust gave high mortality of the adults when applied to the trunk, lower branches and the ground in early May, but it was apparent that treatment of the whole tree would be necessary for the best results. BHC and DDT dusts gave complete mortality of the larvae within 24 hours when applied to the whole tree in mid-June, but

sprays of 1 per cent. wettable DDT or 0·5 per cent. lead arsenate were less effective, though both apparently gave good control by the end of the month.

Zinna (G.). **Su un attacco di** *Dioryctria splendidella* **H.S. in provincia di Benevento. Nota preliminare.** [An Attack by *D. splendidella* in the Province of Benevento. Preliminary Note.]—*Boll. Lab. Ent. agr. Portici* **10** pp. 98–107, 5 figs., 18 refs. Portici, 1951. (With a Summary in English.)

Masses of resin observed on the trunks of pines (*Pinus halepensis*) in a plantation in the Province of Benevento in August 1950 were found to have been caused by larvae of *Dioryctria splendidella* (H.-S.), which had not previously been recorded from southern Italy. The adult, mature larva and pupa and the damage caused by this Pyralid are described [*cf. R.A.E.*, A **19** 124], and its distribution is reviewed from the literature. The larvae were attacked by an unidentified Chalcidoid ectoparasite, the larvae of which became full-fed in 8–12 days and pupated on the body of the host.

Silvestri (F.). [**Compendio di entomologia applicata (agraria-forestale-medica-veterinaria). Parte speciale, Vol. II** (continued).] **Lepidoptera.** —*Boll. Lab. Ent. agr. Portici* **10** pp. 131–303, 104 figs. Portici, 1951.

This is the continuation of the section on the Lepidoptera begun in the earlier part of the second volume of this work [*R.A.E.*, A **34** 10] and was arranged for publication by G. Russo from a manuscript found after the death of the author.

Posnette (A. F.). **New Virus Diseases of** *Ribes*.—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 133–135, 2 pls., 6 refs. East Malling, 1952.

The only one of the virus diseases described in this paper that is transmissible by an insect vector is vein-banding of gooseberry. This disease is common in Kent, and in glasshouse tests the virus was transmitted by the Aphids, *Myzus* (*Nasonovia*) *ribis-nigri* (Mosley), *Aphis schneideri* (Börn.) and *A. grossulariae* Kalt. from infected to healthy gooseberry, but not by *Amphorophora* (*Hyperomyzus*) *lactucae* (L.). The disease stunted the seedlings and appeared to reduce the vigour of some varieties. It was so readily transmitted that control is likely to prove difficult, but propagation of healthy material and effective spraying to control Aphids are desirable.

Posnette (A. F.) & Bovey (R.). **Field Studies on Virus Diseases of Strawberries. I. The Rate of Virus Spread in the Variety Auchincruive Climax.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 136–138, 5 refs. East Malling, 1952.

In connection with studies of the way in which the vector relations of the three viruses or groups of viruses of strawberry that are transmitted by *Capitophorus* (*Pentatrichopus*) *fragaefolii* (Ckll.) in Britain [*cf. R.A.E.*, A **37** 483, etc.] influence their spread and control, an investigation was carried out on the rate at which infection would enter a healthy plot of strawberries in the field and spread in it. Samples of 50 plants were selected between 15th May and 25th June 1951 from five plots that had been set with healthy plants of the variety Auchincruive Climax in 1947, 1948, 1949 or

1950. One young leaf from each plant was infested with 25 examples of *C. fragaefolii* from a virus-free stock, and the Aphids were transferred after two days to healthy plants of wild strawberry (*Fragaria vesca*) and left for seven days. These feeding periods were long enough for transmission of the viruses of mild crinkle and mild yellow-edge (viruses 1 and 2 of Prentice) but not for transmission of the crinkle virus (virus 3) [cf. **39** 426]; however, longer feeding times on detached leaves were practicable only in cool weather.

As all the plots were planted in autumn and the migration of winged Aphids did not occur until the end of May, it was not expected that any plants set out in 1950 would have become systemically infected, and no infections were obtained. The percentages of infected plants from plots set in 1949, 1948 and 1947 were 10, 58 and 100; there were only two transmissions of yellow-edge, the other infected plants showing symptoms of mild crinkle only.

Nicotine dusts were applied to control the Aphids after the spring migration in 1948; plots planted in 1947 and 1948 received parathion in late April or early May in 1949 and 1950, plots set in 1949 received sprays of schradan (Pestox 3) in early June and mid-July 1950, and all the plots were sprayed with parathion at the end of April 1951. Although these treatments reduced the Aphids and sometimes practically eliminated them, the increase in virus infection was rapid. Mild crinkle is readily acquired by Aphids in feeding periods of 30 minutes or less and usually persists in them for less than three hours. As the Aphids become infective immediately after acquiring the virus, it is spread effectively by winged Aphids making short flights from plant to plant and feeding for short periods while depositing their young, and the rate of spread would continue to increase as the proportion of infected plants increased, provided that there were enough Aphids to ensure that every plant was visited. This appears to have occurred in the plots examined, and such rapid spread of infection emphasises the need for renewal of propagation stock every year and for controlling the Aphids before they migrate from infected plants.

Groves (J. R.). **A preliminary Account of the Summer Fruit Tortricid, *Adoxophyes orana* (F.R.), in Great Britain.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 152–154, 2 pls., 8 refs. East Malling, 1952.

Adoxophyes orana (Fisch. v. Roesl.) was observed injuring fruit trees in England for the first time in 1950, when it occurred in an orchard in Kent. It has since been found in many orchards in the county, and typical injury to apples has been noted in other parts of south-eastern England. Damage has occurred on apple, pear, cherry, cherry plum [*Prunus cerasifera*] and plum, though the fruits were attacked only on apple and pear; the Tortricid was also taken on a beech hedge near fruit trees.

Observations showed that there are two complete generations a year. In 1951, adults of the overwintering generation were taken from 23rd June to 26th July and those of the first (summer) generation from 18th August until 15th October. Summer-generation eggs were laid on the leaves of apple in July, and the larvae fed on the tips of green shoots until late July or early August and then on the fruits, chewing out large areas on the surface. Eggs of the second generation were laid on leaves or fruits, on which the larvae fed until the second or third instar, causing less fruit injury than those of the preceding generation. They overwintered on the trees, under dead leaves webbed to twigs, between shoots on a spur, between mummified apples and the branch or in any similar situation, and left their shelters to feed on the unfolding leaves in late March or April. Pupation

occurred in May among the webbed leaves. In the laboratory in summer, the larval and pupal stages averaged 32 and 10 days, adult males and females survived for 8 and 10 days, respectively, and eggs hatched in 10 days. The life-cycle lasted 56 days in the laboratory and about 64 in the field. Females laid 200–379 eggs each in groups of 5–156, the largest groups being laid by the younger individuals.

The only parasite of *A. orana* observed was *Trichogramma evanescens* Westw., which attacked 5–10 per cent. of the second-generation egg-batches on one farm in 1951.

Massee (A. M.). **Transmission of Reversion of Black Currants.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 162–165, 4 refs. East Malling, 1952.

In view of earlier work suggesting that the Eriophyid, *Cecidophyes* (*Phytoptus*) *ribis* (Westw.), is a vector of the virus that causes reversion of black currant [*R.A.E.*, A **15** 482], further investigations were begun at East Malling in 1942. Examples of the mite from infected bushes were transferred to each of 24 healthy bushes at monthly intervals from December 1942 until April 1943, from November 1943 to April 1944 and during the winter of 1944–45. At each transfer, 40 mites were placed on each of 12 buds, and portions of enlarged buds from infected bushes were put in the axils of 12 buds and on the soil. In all, 2,400 mites were transferred to each plant each year. Colonies of the mite became established on all the plants during the first year, and all showed enlarged buds by November 1943. Symptoms of reversion were shown by ten plants in July 1943, nine in August 1944 and all in June 1945. Six uninfested bushes remained apparently normal throughout the experiment.

In other tests, the Mirid, *Lygus pabulinus* (L.), and the Aphids, *Capitophorus* (*Cryptomyzus*) *ribis* (L.), *Myzus* (*Nasonovia*) *ribis-nigri* (Mosley), *Aphis grossulariae* Kalt. and *Amphorophora* (*Hyperomyzus*) *lactucae* (L.) were transferred from infected to healthy plants, but no symptoms developed on the latter over a period of three years.

Dicker (G. H. L.). **Studies in Population Fluctuations of the Strawberry Aphid,** *Pentatrichopus fragaefolii* **(Cock.). I. Enemies of the Strawberry Aphid.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 166–168, 5 refs. East Malling, 1952.

During studies on *Capitophorus* (*Pentatrichopus*) *fragaefolii* (Ckll.) on strawberry, in the main fruit-growing areas of England in 1943–46 and subsequently in Kent, records were made of the natural enemies of the Aphid.

Eight examples parasitised by *Aphidius* sp. and four by *Aphelinus asychis* Wlk. were found in Kent, Worcestershire and the Isle of Ely. Attack by the fungus, *Empusa planchoniana*, was much commoner and was sometimes severe; it was usually observed between May and July, but occasionally in October–December. The chief predators observed were *Anthocoris nemorum* (L.) and larvae of the Staphylinids, *Tachyporus hypnorum* (F.) and *T. obtusus* (L.), which occurred on strawberry with some regularity and may cause the summer decline in populations of *C. fragaefolii*, though no correlation between Aphids and predator populations was detected. The first generation of *Anthocoris* is present in May–July and the second until October. The larvae of *Tachyporus* spp. are present from mid-May until August and are most numerous in June; small numbers of adults are found on strawberry throughout the year. Of the other predators observed, the

Anthocorids, *A. nemoralis* (F.), *Orius niger* (Wolff), *O. majusculus* (Reut.) and *O. laevigatus* (Fieb.), the Mirids, *Deraeocoris ruber* (L.) and *Plagiognathus arbustorum* (F.), the Chrysopid, *Chrysopa carnea* Steph., the Coccinellids, *Rhyzobius litura* (F.), *Adalia bipunctata* (L.) and *Coccinella septempunctata* L., the mites, *Anystis agilis* Banks and *Allothrombium fuliginosum* Hermann, and Syrphid larvae occurred irregularly and in such small numbers as to have a negligible effect on Aphid populations.

Dicker (G. H. L.) & Briggs (J. B.). **Results of some Experiments to control Winter Moth and Tortricid Larvae on Apple.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 169–171, 2 refs. East Malling, 1952.

Investigations were carried out in 1948–50 on the control of *Operophtera brumata* (L.) and Tortricids on apple in Kent. Observations on the test trees and, in 1950, on trees in pots, indicated that hatching of *O. brumata* begins when the buds reach the breaking stage, in late March, and that most of the eggs hatch within ten days. The larvae burrow into the fruit buds and remain hidden until the trees reach the green-cluster stage, and later occur in the blossom buds or among loosely webbed leaves. *Tortrix* (*Cacoecia*) *podana* (Scop.) was the commonest of the Tortricids, followed by *Spilonota ocellana* (Schiff.), and small numbers of adults of (*T.*) (*C.*) *crataegana* (Hb.), *T.* (*C.*) *xylosteana* (L.), *T.* (*C.*) *lecheana* (L.), *T.* (*Pandemis*) *cerasana* (Hb.) and *Argyroploce variegana* (Hb.) and, in 1951, one of *Adoxophyes orana* (Fisch. v. Roesl.) were also reared from the larvae present.

The normal fungicide programme of 2·5 per cent. lime-sulphur at the green-cluster stage and 2 per cent. at the pink-bud stage was applied to all trees except in 1948, when some received either phenyl mercury chloride or wettable sulphur, and all insecticides used at the green-cluster stage were applied with the fungicide.

In 1948, all trees received a 5 per cent. tar-distillate spray in January. Applications of 7 per cent. petroleum oil with 0·1 per cent. wettable DDT on 11th March, of 0·1 per cent. DDT at the green-bud stage on 5th April, and of both caused 91, 79 and 100 per cent. reduction of *O. brumata* and 84, 77 and 96 per cent. of Tortricids, whereas 7 per cent. oil alone on 11th March gave 38 and 82 per cent. reduction; the relatively low kill of *O. brumata* by winter oil was not in accord with laboratory results. DNC in oil was tested in the form of concentrates containing 70 per cent. oil with 1·8 per cent. DNC in 1949 and 2·4 per cent. DNC in 1950. Sprays of 4 per cent. concentrate alone or with 0·1 per cent. DDT in the first half of March gave 81 and 75 per cent. reductions in *O. brumata* and 91 and 88 per cent. reduction in Tortricids in 1949 and 85 and 90 per cent. reduction of *O. brumata* and 88 and 89 per cent. of Tortricids in 1950. Of the sprays applied in April, at the green-cluster stage, parathion at 0·01 per cent. in 1949 and 0·005 per cent. in 1950 (both from a dispersible liquid) gave 64 and 87 per cent. reduction of *O. brumata* and 42 and 89 per cent. of the Tortricids, respectively, and 0·05 per cent. DDT gave reductions of 89 and 98 per cent. of *O. brumata* and the Tortricids, respectively, in 1949 and 85 and 64 per cent. in 1950. The parathion spray was applied rather before the green-cluster stage in 1949 and rather after it in 1950, and this may account for the difference in effectiveness.

The results indicate that commercial control of light infestations of *O. brumata* and Tortricids is given by a winter spray of DNC in oil or by the addition of 0·05 per cent. DDT to the spray of lime-sulphur at the green-cluster stage, whereas both are necessary against heavy infestations.

Dicker (G. H. L.) & Briggs (J. B.). **A Note on the Small Ermine Moth,** *Yponomeuta padella malinella* **Zell.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 172–173, 1 pl., 3 refs. East Malling, 1952.

Hyponomeuta (*Yponomeuta*) *padellus malinellus* Zell., the bionomics of which are briefly reviewed [*cf. R.A.E.*, A **32** 158], was common on apple in Britain before the introduction of efficient winter sprays, but disappeared as a result of the regular use of tar distillate or of DNC in oil. During investigations begun in 1949 to evaluate the effectiveness of winter sprays and various insecticides applied to apple with the pre-bloom fungicides, it was observed that the omission of a winter spray resulted in the reappearance of *Hyponomeuta*. All the trees received 2·5 per cent. lime-sulphur, to which the insecticides were added, at the green-cluster stage, followed by 2 per cent. lime-sulphur at the pink-bud stage; no post-blossom sprays were applied. Concentrates of 70 per cent. oil with 1·8 per cent. DNC in 1949 and 2·4 per cent. DNC in 1950 and 1951, applied in a 4 per cent. spray in early March, gave complete control, with two exceptions that were probably due to incomplete coverage. Green-cluster applications of 0·05–0·1 per cent. DDT in a wettable powder or emulsified solution, 0·005–0·01 per cent. parathion in a dispersible liquid or 0·1 per cent. BHC (about 13 per cent. γ isomer) in a wettable powder caused very slight reductions in infestation, but showed no promise of control.

Groves (J. R.). **Supplementary Measures for the Control of Codling Moth,** *Cydia pomonella* **(L.).**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 174–178, 1 fig., 6 refs. East Malling, 1952.

The author presents evidence collected in England in 1949–51 showing that many larvae of *Cydia pomonella* (L.) overwinter in packing sheds or fruit boxes and that infestation of apple is more severe near the sheds or where the boxes are stacked. There was no evidence that rubbish dumps or apple tips were sources of infestation. The normal spray of 2 lb. lead arsenate per 100 gals. water in early June and again in late June or early July is adequate unless infestation is heavy, but centres of infestation should be treated individually. The insides of packing sheds and their contents, and the tops and sides of stacks of empty boxes that have been used in the previous season should be thoroughly sprayed with 5 lb. 20 per cent. wettable DDT per 100 gals. during the last week in May. Packing sheds should be kept closed as much as possible from the third week in May until the end of July, and spiders' webs should not be removed until late summer, as many moths are trapped in them. An extra lead-arsenate spray should be applied to trees near the packing sheds and stacks unless they are to be harvested less than six weeks after the second application, and to the 2–3 nearest rows of trees whenever a stack of boxes is removed. Banding the scraped trunks of heavily infested trees with sacking or corrugated paper from mid-July until harvest reduces subsequent infestation. Infested fruit should be removed at short intervals.

Paine (J.). **List of Insects occurring on the Hop.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 179–180. East Malling, 1952.

A list is given of upwards of 100 species of insects, excluding Lepidoptera, and a few other organisms that were observed on hops in Kent and Sussex in 1950–51. They are classified as those that feed on hops, those that occur

on them frequently, and those that are only occasional visitors, and within each of these groups, as abundant and probably to be found on every plant each year, common, and uncommon or local.

Hill (A. R.). **Observations on *Lygus pabulinus* (L.), a Pest of Raspberries in Scotland.**—*39th Rep. E. Malling Res. Sta. 1950–51* pp. 181–182, 2 refs. East Malling, 1952.

An account is given of tests in Scotland showing that *Lygus pabulinus* (L.), which feeds on the leaves of raspberry, but causes little damage by so doing, also kills the growing points by feeding on them in the nymphal stage and so causes undesirable branching of the canes. Observations over a period of three years showed that the Mirid has two generations a year on raspberry and that most of the bugs pass their entire life-cycle on it, not migrating to herbaceous plants [*cf. R.A.E.*, A **16** 619]. The nymphs appear on the plants during the last week of May and increase in numbers until the third week in June. Adults appear in the first week of July and are abundant 7–10 days later, decrease in numbers during August and disappear by the third week of August. Nymphs of the next generation hatch from eggs laid on the plants in August and are present until late September or early October. The resulting adults deposit overwintering eggs on the canes. Nymphs of the overwintered and summer generations cause branching that becomes evident in late July and August and in late September, respectively; the latter is near the tip of the almost full-grown cane and of little importance, but the former occurs at a height of about 3 ft. and causes much concern to growers.

Watson (M. A.) & Healy (M. J. R.). **The Spread of Beet Yellows and Beet Mosaic Viruses in the Sugar-beet Root Crop. II. The Effects of Aphid Numbers on Disease Incidence.**—*Ann. appl. Biol.* **40** no. 1 pp. 38–59, 4 graphs, 13 refs. London, 1953.

The following is taken from the authors' summary of this second part of a series [*cf. R.A.E.*, A **40** 142], in which data described in the first are subjected to statistical examination. Multiple regression analysis of the data showed that alates of *Myzus persicae* (Sulz.) of the spring and summer migrations are the most important factor affecting the spread of the yellows virus in the sugar-beet root crop in England. Apterae of *M. persicae* spread little virus, and the contribution of alates and apterae of *Aphis fabae* Scop. was negligible. A simple mathematical formula expressing the spread of infection is given, and the closeness with which it fitted the observed data supported the results of the regression analyses with regard to the alates of *M. persicae*. Once infection had been introduced into the root crops in the spring, spread was mainly within fields or between fields in the same neighbourhood.

In areas where beet and mangel seed crops were grown intensively, some infection was spread to the root crops by summer migrants from infected seed crops. Apart from this, the greater prevalence of yellows in seed-crop areas was caused by the greater development of infestation of the root crops by *M. persicae* that occurs in these areas. The proportion of plants infected by spring migrants entering the root crops before the end of June was small and variable. It did not vary significantly between seed and non-seed areas. This implies either that initial infection came equally from sources other than seed crops, or that, if the seed crops were the main sources of infection, winged Aphids acquired infectivity by visiting them during migration, and later became very widely dispersed.

In contrast to yellows, mosaic virus spread mainly in the neighbourhood of seed crops within the seed-crop areas. No significant relation between Aphid numbers and increase of infection was established, but there is a strong suggestion that alates of *M. persicae* and *A. fabae* spread the virus, and that the contributions of both species are equal. This suggests that mosaic virus is not spread by movement of Aphids within the root crops, but only by infective migrants coming from outside sources. As the virus is non-persistent, the sources must be near to the root crops, and as there is little internal spread, many infective migrants are needed to cause a high level of infection. The seed crops fulfil these conditions as they are often severely infected with mosaic, and both vector species breed on them. The irregularity of the data relating Aphid numbers to mosaic incidence is probably caused mainly by individual variation in the intensity of infection of seed crops, and in the proportion of migrants caught on the traps that actually derive from them.

Hull (R.) & Gates (L. F.). **Experiments on the Control of Beet Yellows Virus in Sugar-beet Seed Crops by insecticidal Sprays.**—*Ann. appl. Biol.* **40** no. 1 pp. 60–78, 2 figs., 5 refs. London, 1953.

The following is taken largely from the authors' summary. Field experiments in eastern England between 1943 and 1951 showed that *Myzus persicae* (Sulz.) was present on sugar-beet stecklings throughout some winters and that most seed-crop plants that developed symptoms of sugar-beet yellows became infected in the steckling bed prior to transplanting. A larger proportion of stecklings sown at the end of July or in early August became infected with the virus than of those sown about a month later. The incidence of yellows was reduced by nicotine at 0·125 per cent. in sprays or 4 per cent. in dusts applied during autumn and early winter at fortnightly and about weekly intervals, respectively, which freed the stecklings from Aphids after the autumn migrations had ceased and thus prevented the spread of the disease during the winter. Greater reductions were obtained with sprays of 0·09 per cent. parathion, 0·24 per cent. schradan, 0·2 per cent. bis(dimethylamino)-fluorophosphine oxide, 0·125 per cent. HETP (hexaethyl tetraphosphate), and 0·33 per cent. DDT with 0·125 per cent. nicotine, but chlordane and DDT alone were less effective; in one test, three applications of parathion reduced the incidence of the disease to one-ninth of that in unsprayed plots. However, in years in which the stecklings were exposed to large numbers of migrating Aphids, infection with yellows was as high as 78 per cent., even in plots sprayed three times. Increased seed yields were obtained from plants treated with schradan, parathion and HETP; nicotine had little influence on yield, and chlordane decreased it. Spraying was usually more effective in September and October than in August. It is concluded that although sprays often greatly reduce the incidence of yellows, and, combined with measures such as growing sugar beet in areas distant from sources of the virus and raising the stecklings under cover-crops, may result in relatively healthy crops, they are unlikely to give adequate control in open beds in years or districts in which many infected Aphids migrate in autumn.

Turner (N.) & Bliss (C. I.). **Tests of Synergism between Nicotine and the Pyrethrins.**—*Ann. appl. Biol.* **40** no. 1 pp. 79–90, 20 refs. London, 1953.

The following is largely the authors' summary. Synergism between nicotine and pyrethrum applied by injection to adults of *Oncopeltus*

fasciatus (Dall.) was reported by the senior author [*R.A.E.*, A **39** 272]. When these insecticides were applied by a dipping technique [**37** 138] alone and as mixtures to adults of *Tribolium castaneum* (Hbst.), the data indicated that independent joint action, and not synergism, occurred. The possibility of similar action was eliminated, because the two insecticides showed varying relative toxicities at different concentrations, thus failing in one of its requirements [*cf.* **28** 200]. It was thought that the absence of synergism might be due to the failure of the nicotine to reach the site of action in the insect while the pyrethrins were still active, since the effect of pyrethrins has been shown to be short-lived [B **37** 81]. A test was accordingly performed in which treatment of the beetles with nicotine was followed after ¾–6 hours by treatment with pyrethrins. Synergism was pronounced when the interval between applications was ¾ hr., but decreased when the interval was longer and practically disappeared when it was six hours. The maximum increase in toxicity observed was about twofold.

David (W. A. L.) & Gardiner (B. O. C.). **Systemic insecticidal Action of Nicotine and certain other organic Bases.**—*Ann. appl. Biol.* **40** no. 1 pp. 91–105, 9 refs. London, 1953.

Since nicotine is highly toxic to insects and is soluble in water, it was thought that it might prove useful as a systemic insecticide, and as such might be less injurious to plants than some other materials. Tests were therefore made with pure nicotine and with aqueous solutions of its citrate, hydrofluoride, metaphosphate and orthophosphate containing 10 per cent. nicotine. Aphids (*Aphis fabae* Scop.) and larvae of *Pieris brassicae* (L.) feeding on broad bean (*Vicia faba*) and young cabbage, respectively, of which the roots were in solutions of these materials were all killed by concentrations of 0·01 per cent. nicotine, fumigant action being excluded, and nicotine was recovered from the leaves of the cabbage plants at rates of up to 380 mg. per kg. after four days; the effectiveness against the Aphids was comparable with that of schradan. The bean plants were severely damaged by a concentration of 0·05 per cent. nicotine and slightly by 0·01 per cent. In similar tests with adults and larvae of *Phaedon cochleariae* (F.) on young turnips, the insects were killed only by concentrations that severely injured the plants. When soil in which infested broad bean, cabbage and turnip plants were growing was watered with solutions of 0·5, 0·1, and 0·01–0·5 per cent. nicotine, respectively, no systemic action was observed and nicotine could not be detected in the plants, but there was slight systemic action in broad beans growing in soil watered four days earlier with 1 per cent. nicotine. No nicotine could be recovered from soil that had been treated four days earlier, even when it was subsequently kept in a stoppered jar, and it is concluded that nicotine is rapidly decomposed in the soil. A solution of nicotine applied several times over a period of two or three days to the upper surface of a bean leaf killed Aphids confined on the lower surface immediately below the treated area. No conclusive evidence of translocation in broad bean was obtained but examples of *Myzus persicae* (Sulz.) placed on the crowns of cabbage plants, of which the lower leaves had been dipped four times daily for four days in 0·5 per cent. nicotine and subsequently removed, were nearly all killed in five days. No leaf absorption or translocation was obtained with the nicotine salts.

Various organic bases, mostly piperidine derivatives and including some piperidine phosphonites, were also applied in solution to the roots of broad beans infested by *A. fabae*, but killed the Aphids only at concentrations that injured the plants.

Blackith (R. E.). **Bioassay Systems for the Pyrethrins. IV. Stoichiometric Relations with Pyrethrum Synergists.**—*Ann. appl. Biol.* **40** no. 1 pp. 106–112, 2 graphs, 18 refs. London, 1953. **V. Experiments with a resistant Strain of** *Calandra granaria* **L.**—*T.c.* pp. 113–120, 3 graphs, 15 refs.

In the first of these two parts of a series [*R.A.E.*, A **39** 50, etc.], reference is made to spray tests against *Aëdes aegypti* (L.) in which the addition of increasing proportions of sesamin or N-isobutylundecylenamide increased the toxicity of pyrethrins until the molecular ratio of synergist to pyrethrins was 1:1, but no further change in toxicity occurred when the ratio was higher [B **38** 36]. Further tests were carried out with pyrethrins and six synergists applied in oil to filter papers on which adults of *Calandra granaria* (L.) were subsequently exposed. A similar result was obtained when the synergist was sesamin, N-isobutylundecylenamide, piperonyl cyclonene, n-propyl isome (a condensation product of isosafrole and n-propyl maleate) and M.G.K. 264 (N-(2-ethylhexyl)bicyclo[2.2.1]-5-heptene-2,3-dicarboximide), the respective mixtures being 3, 1·8, 4·2, 2·3 and 2·2 times as toxic as the pyrethrins alone when the molecular ratio of synergist to pyrethrins was 1:1 or higher. With piperonyl butoxide, however, the relative toxicity of the mixtures reached a peak of 8 when the ratio was 5:1 and became constant at 4·5 when it was 10:1 or higher. D.H.S. Activator (ethylene glycol ether of pinene) showed no synergistic activity [*cf.* B **28** 181]. The molecular volumes of members of the pyrethrins complex all lie within the same limited range as those of the six effective synergists, and it is thus possible that the synergist molecules can replace molecules of pyrethrins almost exactly in films at the nerve interface [B **38** 36]. In work with flying insects [B **38** 34–36], the weight of pyrethrins accumulated within the fixed exposure period was less for insects treated at concentrations slightly above the minimum for paralysis than for those treated at the minimum concentration. This difference implies an increase in absolute toxicity of the pyrethrins, which may be associated with close-packing of the pyrethrin molecules once they have covered the nerve interface. If equivalent synergist molecules formed part of the interfacial film, fewer pyrethrin molecules would be needed to induce close-packing and re-orientation of the molecule to discharge the resting potential at the interface more efficiently.

The second part comprises an account of an attempt to select a strain of *C. granaria* resistant to pyrethrins. Test insects from each generation (and controls) were exposed on filter paper impregnated with different concentrations of pyrethrins to estimate their susceptibility, and the parents of the next were those that survived an exposure that gave about 85 per cent. kill. Resistance in each of 15 successive generations was compared with that of the corresponding generations of the controls. The relative tolerances of the selected and unselected strains could not be well expressed by median response dose ratios because the relevant regression lines were not parallel, and a new method based on the "generalised distance" of P.C. Mahalanobis (1936) was adopted and is described. It gave improved stability, and can equally well be used to compare two different insecticides giving lines of different slope. The mean relative resistance of the selected strains did not alter until the seventh generation, but it then increased until the tenth generation, when it was 3·5 times as great as at first, after which it remained constant. These strains showed no significantly enhanced cross-resistance to DDT. The tolerance of each of the four selected strains fluctuated throughout the experiment, even when selection was discontinued for six generations, and that of the unselected strains remained constant

for two years during which they were subjected to marked temperature variations, but then began to fluctuate following transference to constant temperatures. The fluctuation appeared to be due to a repetitive process acting over several generations, and not to a mutation or other single event.

Howe (R. W.). **Studies on Beetles of the Family Ptinidae. VIII. The intrinsic Rate of Increase of some Ptinid Beetles.**—*Ann. appl. Biol.* **40** no. 1 pp. 121–133, 17 refs. London, 1953.

The following is based almost entirely on the author's summary of this part of a series [*cf. R.A.E.*, A **40** 202, etc.]. The intrinsic rate of increase (*r*) was calculated by methods described in a paper already noticed [**38** 91] for nine species of Ptinids that infest warehouses in Britain from data obtained in laboratory studies of their bionomics at constant temperature and humidity. The highest value for *r* was 0·38, which is equivalent to a weekly increase of 39 per cent. or a tenfold increase in under two months, and this was obtained for *Ptinus tectus* Boield., the only species of economic importance in Britain, reared in isolated pairs. *Gibbium psylloides* (Czenp.), *Mezium affine* Boield., *Stethomezium squamosum* Hinton and *Trigonogenius globulus* Sol. were capable of a tenfold increase in three months, and the remaining four multiplied more slowly, because of a low oviposition rate (*Eurostus hilleri* (Rttr.)), high developmental mortality (*Niptus hololeucus* (Fald.)), or slow development (*P. fur* (L.) and *P. sexpunctatus* Panz.).

In general, the intrinsic rate of increase fell with temperature as a result of the longer development period and reduced oviposition, but it also fell at temperatures near the upper limit for development because of high mortality. *N. hololeucus* had a higher rate of increase at 20°C. [68°F.] than at 25°C. [77°F.], which is close to its developmental maximum. Relative humidity had little effect except at the limits of humidity tolerance, but water must be occasionally available for the adults, or oviposition and thus rate of increase are markedly depressed. Food affected the rate of increase mainly through its effect on rate of development. The effects of light [**40** 5], disturbance and density are also briefly discussed; the value of *r* was reduced to 0·33 for *P. tectus* reared in groups.

The statistic *r* applies to a population with a stable age distribution. For Ptinids, the stable age population was found by calculation to contain between 5 and 11 per cent. of adults, whereas adults never formed less than 15 per cent. of the population in the warehouse. The actual observed rates of increase in a warehouse reached a value equivalent to $r = 0{\cdot}24$ per week over a period of eight weeks. From observed temperature means and laboratory results, a maximum of $r = 0{\cdot}31$ was predicted with a mean of 0·19 per week for a year. The value of *r* obtained using the oviposition rate estimated in the warehouse was 0·1. Warehouse values of *r* may be below those predicted from laboratory results because oviposition is restricted by lack of drinking water and often by overcrowding, mortality is increased by disease, parasites, predators and accidental cannibalism, and the rate of development is retarded by crowding.

Howe (R. W.). **The rapid Determination of the intrinsic Rate of Increase of an Insect Population.**—*Ann. appl. Biol.* **40** no. 1 pp. 134–151, 6 figs., 10 refs. London, 1953.

The following is almost entirely the author's summary. A description is given of the primitive (single oviposition period) method, applicable to an insect species that lays all its eggs quickly, for determining the finite rate of

natural increase (λ) [defined in a paper already noticed (*R.A.E.*, A **38** 91) as the number of times the population multiplies in a unit of time], together with a summary of a more accurate method [*loc. cit.*] of calculating the intrinsic (infinitesimal) rate of increase (*r*) of any species. The parameter *r* is the natural logarithm of the parameter λ. Two modifications that simplify this more accurate method are discussed and illustrated by examples from the literature, which are used to compare the results given by all four methods. The species considered are *Tribolium confusum* Duv., *Calandra oryzae* (L.) [*loc. cit.*], *Trigonogenius globulus* Sol., *Ptinus fur* (L.) [see last abstract], *Lasioderma serricorne* (F.) [**7** 366; **26** 164; **32** 185] and *Tenebrio molitor* L. [**26** 164].

The first modification provides a means of representing a long oviposition cycle by a single figure so that the final calculation resembles the primitive single-period method. The oviposition period is divided into a number of convenient unit periods, and by the use of a table of weighting factors provided, the number of eggs laid in each of these unit periods is converted into the number of eggs required to be laid in the first of them to make an equivalent contribution to the rate of increase. The equivalent oviposition figures for all the unit periods are summed to provide one figure, which represents the observed egg number and pattern.

The second modification provides a means of representing the observed pattern of egg laying by a constant rate of oviposition. This requires the same table of weighting factors, but also needs a series of charts, which are provided. This method usually gives a good answer at the first attempt, whereas the first modification usually requires two trial and error solutions to give an accurate estimate of *r* and hence of λ. The minimum requirements for estimation of *r* are information on the length of the developmental cycle, the rate of egg output, mortality of all stages and the sex ratio.

Lubatti (O. F.) & Smith (B.). **Determination of Fumigants. XIX. Sorption of Methyl Bromide by Onion Seed.**—*J. Soc. chem. Ind.* **67** pp. 297–309, 16 figs., 37 refs. London, 1948. **XX. Sorption of Methyl Bromide by Potatoes.**—*T.c.* pp. 347–354, 13 figs., 15 refs.

Wade (P.). **XXII. Photometric Determination of brominated-hydrocarbon Fumigants as inorganic Bromide.**—*J. Sci. Fd Agric.* **3** no. 9 pp. 390–393, 3 graphs, 15 refs. London, 1952.

The following are virtually the authors' summaries of these papers, which form parts of a series [*cf. R.A.E.*, A **32** 144, 184; **33** 128; **38** 510; **39** 54].

The sorption of hydrocyanic acid gas, ethylene oxide, trichloroacetonitrile and methyl bromide by wheat, soy beans, sultanas, groundnuts and onion seed was investigated. The factors affecting the sorption of methyl bromide by onion seed were studied. The rate of sorption appears to be governed by diffusion. A detailed study of the effect of moisture content on the sorption of methyl bromide by onion seed whole and ground and by wheat and wheat-meal was carried out. Some hints on the behaviour of sorbed fumigants in dry and wet seeds were obtained. The effect of the sorption of methyl bromide on the germination of onion seed was investigated.

The effect of the following factors on the sorption of methyl bromide by potatoes was determined: concentration of fumigant, period of exposure, size of tubers, temperature, maturity, induced sprouting and variety. At the concentration-time product studied, residual methyl bromide is small and becomes negligible after five to ten days. A few experiments on the sorption of methyl bromide by light loamy soil were carried out.

A photometric procedure based on the reaction between bromides and sodium gold chloride was developed as another means of measuring the

bromide formed in the determination of fumigants such as methyl bromide, and ethylene dibromide, by catalytic oxidation of the gas and its subsequent absorption in an alkaline solution containing hydrogen peroxide. The method is applicable to solutions containing 0·1–4 mg. of inorganic bromide in a volume of 8 ml. Extinctions are measured by means of a Spekker photoelectric absorptiometer. Results obtained in a series of experiments with ethylene dibromide are given, and compared with a similar series in which the bromide formed was determined by potentiometric titration with silver nitrate.

Blackith (R. E.) & Gorringe (B. S.). **Responses of Pests to Fumigation. I. Toxicity of Mercury Vapour to the Eggs of** *Calandra granaria* **(L.).** —*Bull. ent. Res.* **44** pt. 2 pp. 217–224, 1 graph, 7 refs. London, 1953.

The following is virtually the authors' summary. Females from wild populations of *Calandra granaria* (L.) obtained from six sources in Britain were allowed to oviposit in clean wheat, and the tolerances of the eggs to mercury vapour were estimated. The median lethal doses ranged from 55 to less than 1 mg.hr./m^3. A laboratory strain of *C. granaria* developed resistance to mercury vapour in the egg stage, probably as a result of contamination of an incubator. Such evidence as is available suggests that this resistance is associated with reduced permeability of the chorion rather than with enhanced metabolic ability. The increase in resistance is such that no attainable concentration-time product will kill more than half the resistant egg population, which is thus virtually in equilibrium with air saturated with mercury vapour. Fumigation of gravid females, or of wheat over a period of two years prior to oviposition, does not reduce the viability of any eggs subsequently laid.

Salmond (K. F.). **Responses of Pests to Fumigation. II. Toxicity of Hydrogen Cyanide to** *Calandra* **spp. under reduced Pressure.**—*Bull. ent. Res.* **44** pt. 2 pp. 225–230, 4 graphs, 4 refs. London, 1953.

The following is virtually the author's summary. Adults of *Calandra granaria* (L.) and *C. oryzae* (L.) were fumigated with hydrocyanic acid gas by the methods of sustained pressure reduction and preliminary pressure reduction, the main criterion of response being death. Of the factors studied, starvation and sex were without influence. With pressure reduction, Haber's rule relating mortality, concentration and period of exposure [*R.A.E.*, A **23** 121] was not followed; for a given concentration-time product, mortality became higher as the period of exposure became shorter. Preliminary pressure reduction increased mortality much less than sustained pressure reduction. With the latter, mortality of *C. oryzae* was greater than that of *C. granaria*. The increases in susceptibility are largely accounted for by increases caused by pressure reduction alone in the absence of fumigant. The number of eggs laid by untreated females and by females surviving treatment was excessively variable, and no discrimination between factors could be made.

Sellers (W. F.). **A Critique on the Time Factor in Biological Control.**—*Bull. ent. Res.* **44** pt. 2 pp. 273–289, 1 fig., 10 refs. London, 1953.

The author discusses the views of Clausen [*R.A.E.*, A **39** 262] and Thompson [**40** 300] as to the significance of the time factor in the control of a pest by an introduced parasite or predator in the light of his own

conclusions based on observations in the past 29 years. He considers Clausen's contention that if such a natural enemy is to be fully effective, it will achieve commercial control within three host generations, or at most within three years, in the vicinity of the liberation point, to be supported by observed facts, and emphasises the importance in this connection of environment. He points out that in most instances where an introduced species has given effective control, it was the only one involved, a high pest population and a satisfactory environment and host relationship enabled it to approach its potential reproductive rate, and the time required for effective control appeared to depend essentially on its rate of dispersal.

There is a time-lag in control associated with the initial establishment of an introduced species that is not evident in the control of subsequent outbreaks. The main factors involved in this are initial distribution and rate of dispersal, and a parasite does not exert its maximum controlling effect until an equilibrium of distribution is established. This equilibrium requires outward dispersal from an area to be matched by inward migration into it, and the density level at which it is attained is affected by the size, number and distribution of the initial colonies. Equilibrium of distribution and effective control are attained sooner, though over a relatively smaller area, when dispersal is slow than when it is rapid. Species with a slow dispersal rate reach equilibrium at a high density and are best assisted by releasing many small colonies at scattered points, whereas the liberation of a few large initial colonies followed by additional colonisation in the next generation is more suitable for insects with a rapid rate of dispersal, in which the density at equilibrium is low. Introduced species that will ultimately become fully effective characteristically bring marked outbreaks under rapid control, after which the pest population oscillates at a relatively low level. A consideration of the limitations of several introduced species that have given satisfactory control indicates that the value of a beneficial insect should be regarded not as a constant, but as a variable depending on a general background of controlling factors.

In extending the theory to beneficial species that are only partially effective, the author reviews the history of parasites in this category that were introduced into the north-eastern United States against *Lymantria* (*Porthetria*) *dispar* (L.) [**18** 170; **33** 238]. He concludes that for such insects, the initial time-lag continues beyond the three-year period specified by Clausen for fully effective ones, and that, after establishment, the effectiveness of the parasites is conditioned by the normal duration of heavy outbreaks of *L. dispar*, which rarely exceeds three years. Many of the parasites are as effective in their new environment as in those from which they came, and the degree of control achieved is now substantially the same as that obtaining in central Europe. Since a species that is to become a useful, though not completely effective, control agent does not in general show its value within three years, the adoption of Clausen's conclusion may involve a risk of the premature cessation of colonisation programmes.

Connell (J. U.) & Jones (G. D. G.). **Observations on the Entry of Dusts into the respiratory System of the Adult Worker Honey Bee,** *Apis mellifera* **L.**—*Bull. ent. Res.* **44** pt. 2 pp. 291–298, 1 pl., 7 figs., 6 refs. London, 1953.

The spiracles of honey bees were studied in connection with an investigation in Britain of the risks associated with the use of insecticidal and other dusts in crop protection. The following is largely the authors' summary of the work. The hair structures associated with the spiracles of the adult worker are described. The surface hairs round the spiracular orifices vary

in size, density and arrangement, and an experiment in which bees flew through a cloud of china-clay dust showed that, with the exception of those of three of the abdominal spiracles, they appeared capable of retaining particles greater than 30μ in diameter. When bees in flight were exposed to dust clouds of charcoal and cuprous cyanide, no particles were found in any internal part of the respiratory system beyond the spiracles, except in the case of the trachea of the first thoracic spiracle, which contained charcoal particles less than 5μ in diameter. A study of the mechanism of tracheal ventilation provided some evidence that, unlike those of *Melophagus ovinus* (L.) [*R.A.E.*, B **33** 190] all the spiracles of honey bees are inspiratory in function.

Little information is available on the range of particle-size in inert diluents used in insecticidal dusts, but observations on china-clay dusts showed that there was considerable aggregation when the particles were less than 5μ in diameter. In view of this and of the improbability that bees in the field would be exposed for long to clouds as dense as those tested in the laboratory, it is concluded that the entry of dusts into the respiratory system is unlikely to be of much importance.

Okay (S.). **Formation of green Pigment and Colour Changes in Orthoptera.** —*Bull. ent. Res.* **44** pt. 2 pp. 299–315, 1 fig., 32 refs. London, 1953.

The following is substantially the author's summary. In view of conflicting findings in the literature on the production of green pigment in species of Orthoptera with two colour forms [*cf. R.A.E.*, A **20** 671; **34** 350], the factors influencing it were investigated in the laboratory, the predacious *Mantis religiosa* L. and the phytophagous *Locusta migratoria migratorioides* (R. & F.), *Schistocerca gregaria* (Forsk.), *Carausius* (*Dixippus*) *morosus* Brunn. and *Acrida* sp. serving as test insects. None showed any colour reaction when the nymphs were kept on green, brown or yellow backgrounds. The young nymphs of *M. religiosa* were usually green, but some of the older nymphs and the adults showed a tendency to lose the green pigment. Nymphs of the other species became green only when fed on fresh or growing grass or wheat or, in the case of *Carausius*, fresh privet [*Ligustrum*]. Green nymphs of *L. m. migratorioides* and *C. morosus* were obtained in this way even when they were reared in darkness. The green pigment was lost in nymphs of *L. m. migratorioides*, *S. gregaria* and *Acrida* sp. fed on dry grass and nymphs of *C. morosus* fed on dry privet.

The colour change to and from green is dependent on the formation and disappearance, respectively, of the blue component (bile pigment-protein) of green pigment. The blue pigment generally appeared first in the blood and was deposited in the integument at the following moult; it did not appear to be a break-down product of chlorophyll or haematin, and is probably synthesised from a colourless precursor in the peripheral fat-body. Observations on the pericardial cells of *L. m. migratorioides* fed on dry grass suggest that the blue pigment is lost by conversion into a reddish-brown one, which may be insectorubin.

Peake (F. G. G.). **On a Bostrychid Wood-borer in the Sudan.**—*Bull. ent. Res.* **44** pt. 2 pp. 317–325, 8 figs., 6 refs. London, 1953.

The Bostrychid, *Sinoxylon senegalense* Karsch, is the most important pest of felled logs of *Acacia seyal* in the Anglo-Egyptian Sudan, and also attacks *A. albida* and *A. arabica*. Infested timber of *A. seyal* is rapidly destroyed and can be detected by the crackling noise made by the

beetles and the large quantities of wood dust ejected by them. Insectary investigations on its bionomics and control showed that the eggs were laid close together in superficial galleries in the wood, and that the larvae tunnelled for only a few inches up and down the logs. Development to the adult stage lasted about eight weeks, but the adults, which cause the main injury, apparently tunnel extensively in all directions for a further ten months and then emerge from the logs more or less simultaneously. Mass emergence was observed between 7th and 15th April, and no beetles were found in logs collected in the field at that time. After leaving the logs, the beetles tended to congregate under loose bark or in crevices for one or two days, during which mating probably took place. Freshly cut logs and old ones with or without bark were then readily attacked, but the beetles that entered the fresh logs soon died. If this was due to the sap, it would be of little practical value, owing to the rapidity with which the logs dry out in the field; the fresh logs used were of a type with greenish bark that is said to be immune, but shows no specific or varietal characters separating it from the type with red bark. Freshly cut logs from which the bark had been removed were less readily attacked. The logs were invariably entered from the lower surface, even when they were placed on end on unpalatable substances such as paper, pine wood or felt, the beetles first boring through these; but logs standing in sand were not attacked. It would be possible to reduce infestation to a low level in this way, but the protection would not be maintained if the logs were subsequently stacked on their sides.

In experiments in which logs were subjected to various treatments and subsequently exposed to attack in cages, effective protection was given by soaking in hot and cold dips containing 1·3 or 2·6 per cent. (v/v) sodium arsenite for one day; to obtain effective penetration the logs should not be cooled in the air, but either be rapidly transferred from the hot to the cold solution or left submerged in the hot one until it cools. Experience in Northern Rhodesia has shown that sodium arsenite can be safely used in this way provided that the hands and feet of the labourers are covered. Soaking in hot and cold solutions of boric acid at the same concentrations gave inconclusive results, and the treated logs were readily attacked by mould. Spraying logs, freshly cut and barked, with a solution of 5 per cent. (w/w) pentachlorophenol in oil gave good protection and appeared to be the most promising treatment available. Its advantages are that it can be carried out in the forest, thus avoiding risk of attack on the way to the mill, it is not affected by local temperatures or rainfall, and there is no persistent odour; it must be carried out immediately after felling and barking, however, and did not confer protection from *Lyctus*.

Beetles of other families were found in association with *S. senegalense* in the logs, but were of little importance. Adults and larvae of the Clerid, *Cylidrus fasciatus* Lap., occurred in galleries containing larvae of *S. senegalense* and probably destroy large numbers of them. On one occasion, *Platyspathius pictipennis* Vier. and another Braconid of a genus close to *Doryctes*, which was the commoner, emerged from a log of *A. albida* infested only by *S. senegalense*; the wood of *A. seyal* is much harder than that of *A. albida*, and probably cannot be penetrated by the ovipositors of these parasites.

Edney (E. B.). **The Construction and Calibration of an electrical Hygrometer suitable for microclimatic Measurements.**—*Bull. ent. Res.* **44** pt. 2 pp. 333–342, 5 figs., 6 refs. London, 1953.

The electrolytic hygrometer described is based on the principle of the Gregory hygrometer, but the element is considerably smaller (about

6 × 6 × 10 mm.). The element consists of two platinum-clad nickel-iron electrodes round which is wound a spiral of continuous fibre-glass wool yarn impregnated with a solution of calcium chloride. The water content of this salt, and consequently the resistance between the electrodes, varies with relative humidity, and this resistance is measured by micro-ampere records of alternating current of a known voltage. The resistance also varies with temperature, and calibration must be carried out at different constant temperatures covering the range at which the instrument is used. The temperature of the element is measured by a fine thermocouple permanently attached to it. An element impregnated with 1 per cent. calcium chloride gives readings correct to within 2 per cent. for relative humidities of 50–98 per cent., and one impregnated with 5 per cent. calcium chloride is satisfactory for humidities of 10–60 per cent.

Details are given of the design of the hygrometer element and a suitable wiring circuit and of apparatus and methods for calibrating it in the laboratory and recalibrating it in the field. An ageing process is necessary before calibration, and recalibration is required at about fortnightly intervals during constant use. The advantages of instruments of this type for micro-climatic work are that they are small, can be read at a distance, and do not depend upon evaporation of water, so that disturbance of the natural environment is minimised. The main disadvantages are that they cannot be exposed to saturated air without going out of calibration and that each instrument must be calibrated individually, so that they cannot easily be standardised for mass production.

Lamb (K. P.). **A Revision of the Gall-mites (Acarina, Eriophyidae) occurring on Tomato (*Lycopersicum esculentum* Mill.), with a Key to the Eriophyidae recorded from solanaceous Plants.**—*Bull. ent. Res.* **44** pt. 2 pp. 343–350, 1 fig., 18 refs. London, 1953.

From a study of the records, descriptions and morphology of the Eriophyid mites reported as injurious to tomato, the author concludes that only two species are involved. These are *Vasates* (*Phyllocoptes*) *lycopersici* (Massee) [*R.A.E.*, A **26** 103], of which *V.* (*P.*) *destructor* (Keif.) [**29** 565] is a synonym, and *Aceria* (*Phytoptus*) *lycopersici* (Wolff.), of which *Eriophyes lycopersici* Massee [**27** 636] is a synonym. The name *Phytoptus* or *Eriophyes calacladophora*, which is a *nomen nudum* diversely attributed to Nalepa and Rolfs, has been applied by several authors to *A. lycopersici* [*cf.* **3** 178; **7** 196], and this mite has been misidentified on tomato as *A.* (*E.*) *cladophthirus* (Nal.) [*cf.* **15** 522; **23** 277, 624, 713; **25** 15]. *V. lycopersici* (russet mite) causes bronzing of the stems and leaves of tomato, is also recorded from several other solanaceous plants, and occurs in New Zealand, Australia, the United States, Hawaii, Ceylon and possibly Spain. The dimensions of examples taken on tomato and *Physalis peruviana* in New Zealand are shown in a table. *A. lycopersici* (erineum mite) causes white, hairy patches to develop on the stems and leaf-stalks of tomato, its only recorded food-plant, and occurs in North Africa, South Africa, Spain, Italy, the West Indies and Florida.

A list is given of the five species and varieties of Eriophyids other than *V. lycopersici* and *A. lycopersici* that are known from solanaceous plants, showing their synonyms. They belong to the genus *Aceria* and include the true *A. cladophthirus*, which is recorded from the Soviet Union, Britain and other parts of Europe and attacks *Solanum dulcamara*. A table showing the food-plants and distribution of all the forms dealt with and a key to them are appended.

Geering (Q. A.). **Studies of *Lygus vosseleri* Popp. (Heteroptera, Miridae), a Pest of cultivated Cotton in East and Central Africa. I. A Method for breeding continuous Supplies in the Laboratory.**—*Bull. ent. Res.* **44** pt. 2 pp. 351–362, 1 pl., 2 figs., 7 refs. London, 1953.

In view of the desirability of a closer study of the nature of the damage caused by *Lygus vosseleri* Popp. to cotton in Uganda and the possibility of plant resistance to it, a laboratory method of breeding the Mirid so as to provide a continuous supply of insects was developed. A detailed account is given of the work leading to the technique adopted, with some observations on bionomics. The adults readily oviposited in cotton seedlings, but damaged the tissues in feeding, so that the eggs failed to hatch. Portions of developing sorghum panicles proved more satisfactory; grains in the milky stage remained moist long enough for eggs laid in them to hatch, provided that the ratio of adults to grains was kept low, and a ratio of 1:50 was found effective. The grains were exposed to adults in oviposition cages for 3–4 days and then transferred to hatching cages; when the nymphs hatched, they were transferred to rearing cages in which fresh, immature sorghum grains were provided every two days. The hatching and rearing cages consisted of muslin-topped, celluloid cylinders fitting on to shallow tins containing moist vermiculite covered by plaster of paris; the sorghum stems were inserted into small holes in the latter.

At insectary temperatures, the durations of the egg and nymphal stages averaged 8·4 and 16·7 days, respectively, and the adult females survived for up to 57 days. The maximum numbers of nymphs obtained per female per day were 1·5 under mass-rearing conditions and 2·95 from isolated pairs. Mortality of the eggs was high owing to the development of fungi on the grains; dipping the latter in a copper fungicide controlled the fungi but killed the eggs. Mortality of the nymphs averaged 44 per cent. and occurred chiefly in the first instar, probably as a result of handling. In order to reduce handling, the grains containing eggs were alternated in rows with fresh grains introduced when the eggs were due to hatch. Oviposition cages capable of maintaining 200 females in groups of 25 proved adequate to supply the required numbers and are described.

Successive sowings of sorghum made to secure a continuous supply of young grains were attacked by *Contarinia sorghicola* (Coq.) [see next abstract] and by Anthomyiids including *Atherigona* sp., the larvae of which destroy the central part of the young shoots and delay flowering; the loss of the shoots is largely offset by the production of extra tillers. The Anthomyiids were controlled by dusting the bases of the young plants, where the eggs are laid, and the soil round them shortly after germination and thereafter at weekly intervals until the plants were 2 ft. high, with a mixture of DDT and BHC. Comparison of many varieties showed that dwarf habit, early maturity, open panicles, long seed-stems and large grains were desirable for rearing purposes. *Eleusine coracana*, on which *L. vosseleri* breeds freely in Uganda, was not suitable as the grains are small and dry out rapidly.

The methods developed for the mass-rearing of *L. vosseleri* proved satisfactory for *Megacoelum apicale* Reut., which also breeds on sorghum and cotton in the field, though its importance as a pest of cotton is not known.

Geering (Q. A.). **The Sorghum Midge, *Contarinia sorghicola* (Coq.), in East Africa.**—*Bull. ent. Res.* **44** pt. 2 pp. 363–366, 7 refs. London, 1953.

The Cecidomyiid, *Contarinia sorghicola* (Coq.), was recorded for the first time in Uganda in 1951, when it was found attacking early varieties of

sorghum in succession plots sown for experimental purposes [see preceding abstract] in a district where sorghum is not grown for food, though small quantities are used for brewing. The only previous record from Africa was from the Anglo-Egyptian Sudan [*R.A.E.*, A **24** 441]. Attack was negligible on the early varieties, but increased in intensity as the season progressed until 50 per cent. of the grains on the latest varieties were destroyed and secondary tillers produced by the early ones were completely sterilised. To enable seed to develop, the panicles had to be enclosed in paper bags from the time of their emergence from the sheath; this was done continuously from January to October 1952, and populations were greatly reduced as a result. Some panicles were left unprotected throughout the period, and the numbers of adults reared from them reached a peak of 60 per 100 grains in early March. The population was subsequently reduced as a result of parasitism of the larvae by *Tetrastichus* sp., *Aprostocetus* sp. and, to a less extent, *Eupelmus* sp., which increased to 100 per cent. in early April. The development of *Contarinia* lasted 19–25 days. Diapausing larvae were found in December, February, March and April, and all gave rise to adults in early August, after a period of high humidity [*cf.* **30** 365]. Cecidomyiids morphologically indistinguishable from *C. sorghicola* were reared from *Sorghum verticilliflorum*, which is widespread in the bush and a common fallow weed, and *Eleusine coracana*, which has not hitherto been recorded as a food-plant of *C. sorghicola*.

Enquiries in other parts of East Africa showed that *C. sorghicola* also damages sorghum in Tanganyika and Kenya, and S. H. Evelyn reported that in 1950 he observed it in Nyasaland. It is an established pest in the Aden Protectorate, and is stated in an editorial foot-note to have been recently received from Gambia and Nigeria and to be causing serious damage to sorghum in the Gold Coast. It is known to breed on *S. sudanense* and *S. halepense* [**30** 365], which, like *S. verticilliflorum*, are indigenous in Africa, and it may be present in all areas where wild species of *Sorghum* occur. There is no evidence in the literature of resistance to attack in sorghum, but Evelyn has obtained indications of such resistance in the Gezira (Sudan).

Kitchen (W. H.) & Gall (D.). **A controlled Humidifier for Insect Breeding Rooms.**—*Bull. ent. Res.* **44** pt. 2 pp. 367–369, 1 fig., 1 ref. London, 1953.

A description is given of an atomiser, with controlling hygrostat, that proved satisfactory for raising the humidity of a large insect-breeding room without lowering its temperature. Air was blown through one of two nozzles apposed at right angles, the other being connected to a water reservoir, using a compressor motor controlled by a hair hygrostat operating a hot-wire vacuum switch.

Simmonds (F. J.). **Inter-relationships of the Parasites of the Frit-fly, *Oscinella frit* (L.), in eastern North America.**—*Bull. ent. Res.* **44** pt. 2 pp. 387–393, 17 refs. London, 1953.

The following is substantially the author's summary. An account is given of studies in Canada on the extent and importance of competition among parasites of the larvae and pupae of *Oscinella frit* (L.) made in connection with the proposed introduction of suitable species into England for the control of this Chloropid [*R.A.E.*, A **40** 368]. In Ontario, larvae of *O. frit* are first liable to attack by *Hexacola* sp.; by July–August, 30–40 per cent. are parasitised by it, and superparasitism is therefore likely. Attack by

Polyscelis sp. may subsequently occur, but is probably unsuccessful. Competition between the parasites of the larvae and the pupal ectoparasites, *Callitula bicolor* Spin. and *Spalangia drosophilae* Ashm., is generally slight, because *Callitula* is not abundant and *Spalangia* tends to select only unparasitised hosts.

The interrelations of these two pupal parasites and the pupal endoparasite, *Loxotropa* sp. [**40** 369], were investigated by exposing puparia of *Drosophila melanogaster* Mg. to two species simultaneously and in succession. When *Callitula* and *Spalangia* were allowed to oviposit simultaneously, the former was the more successful when hosts were relatively few, but otherwise the two species were equally successful. When *Callitula* parasitised puparia recently exposed to *Spalangia*, equal numbers of the two parasites emerged, but in the reverse experiment, *Callitula* was superior. *Callitula* parasitised a proportion of the puparia already containing *Spalangia* whatever the age of the latter; mature *Spalangia* in puparia thus attacked were mostly killed. Comparisons of *Callitula* and *Spalangia* with *Loxotropa* showed that the latter is inferior to both the others, but that all three tended to avoid multiple parasitism.

It is concluded that, in general, there is little interference between the various species in the parasite complex, which appears to be well balanced. Moreover, when one species does not attain its accustomed degree of parasitism, there is a compensating increase in the numbers of one or more of the others.

Dresden (D.) & Oppenoorth (F. J.). **Residual Effect, Skin Application and Injection of γ-Hexachlorocyclohexane in** *Drosophila melanogaster*. —*Bull. ent. Res.* **43** pt. 4 pp. 581–586, 4 graphs. London, 1953.

Oppenoorth (F. J.) & Dresden (D.). **Selection of a BHC-resistant Strain of** *Drosophila melanogaster* **Mg.**—*Op. cit.* **44** pt. 2 pp. 395–400, 3 graphs, 8 refs. 1953.

The two important aspects of the study of strains of insects resistant to insecticides are the development of resistance, which is a genetical problem, and the difference between normal and resistant individuals, which is a physiological problem. It would be of interest to use *Drosophila melanogaster* Mg. for studies of the genetical problem, as it is well known genetically and is closely related to *Musca domestica* L., in which the most outstanding examples of resistance are to be found, although its small size is a disadvantage in physiological investigations. It was accordingly used in the experiments described in the first of these papers, which are concerned with the evaluation of experimental procedures. The insecticide used was γ BHC because physiological investigations on its action are in progress. It was tested by injection of an emulsified solution, topical application of acetone solutions to the skin, and exposure of batches of about 50 insects for 24 hours in test tubes lined with filter paper impregnated with a deposit from an acetone solution. The methods used are described with particular attention to the technique of injection and the manner of estimating regression lines. The median lethal doses by injection and topical application were 0·00141 and 0·0099 mmg. γ BHC per insect, respectively; by the contact method they were 1·71 mmg. per 90 sq. cm. for the mutant strain used for the topical and injection tests and 2·18 mmg. per 90 sq. cm. for a Berlin inbred strain. The reproducibility of the results obtained is briefly discussed. It was found that in the case of the skin-application and injection methods, the regression line did not deviate significantly from linearity. The same was true for the contact method if the results obtained with the smaller doses were not taken into consideration.

In the experiments described in the second paper, which were carried out by the same methods, adults of two wild strains of *Drosophila* and the inbred Berlin strain were used. Successive generations were reared from adults that had survived exposure to deposits of γ BHC causing 60–80 per cent. mortality, and resistance appeared in all three strains to about the same extent and after about the same number of generations, although their original susceptibilities were different. It thus appeared that differences in homogeneity of the original material had no influence on the final result of selection, and all subsequent tests were made on one of the strains (W1) from wild flies. Resistance in W1 was produced in 13 selections and was not much greater after 24, when the median lethal deposit in mmg. per 90 sq. cm. was 6·9 as compared with 1·6 for the unselected flies. Adults of the 24th selection also showed resistance to γ BHC applied topically and by injection and to kill by DDT and knockdown by Thanite. F_1 adults from reciprocal crosses between W1 and resistant W1 resembled one another in reaction to γ BHC and resembled the resistant parent strain more than they did the susceptible one. It follows that resistance does not depend on cytoplasmic heredity and that it is incompletely dominant.

The fact that resistance developed to the same degree in the three populations used appeared to exclude the possibility of it being due to mutation and suggested that it resulted from a change in frequency of one or more of the genes present.

Bartlett (B. R.). **A Study of Insecticide Resistance in Strains of *Drosophila melanogaster* Meig.**—*Canad. Ent.* **84** no. 7 pp. 189–205, 3 figs., 24 refs. Ottawa, 1952.

The following is virtually the author's summary. Sixteen strains of *Drosophila melanogaster* Mg. representative of diversified climate and food habits were assembled from laboratory and field sources. These strains were isolated as family lines and tested for extent of susceptibility to DDT (a contact poison), tartar emetic (a stomach poison) and hydrocyanic acid gas (a respiratory poison). Suitable test methods for adequate evaluation of small differences in susceptibility between the strains were developed. Differences between strains in resistance to all three poisons were demonstrated. Resistance was shown to be inherited and not associated with nutrition. Successive selective insecticidal treatments resulted in increased resistance in some strains, but not in others. The rate of increase in resistance to DDT and HCN was very slow. Evidence of more than one level of DDT-resistance in relatively isogenic strains suggests that this resistance develops in steps. Resistance to DDT and HCN was tested with adults only. Resistance to tartar emetic was demonstrated in both adults and larvae but was more pronounced in the larvae. Several strains were markedly resistant to tartar emetic. This resistance was not specific for tartar emetic, but extended in some degree to DDT and to HCN.

Resistance by the strain most highly resistant to HCN was shown to have some specificity for HCN, since this strain was not resistant to DDT or tartar emetic. Adults of this strain were shown, however, to be resistant to diethyl ether and to a subfreezing temperature (10°F.), as well as to anaesthesia induced from either of these two treatments. Inheritance of resistance to HCN was indicated as being without sex-linkage.

The strain of *D. melanogaster* showing greatest resistance to DDT was also highly resistant to fluoro-DDT, moderately resistant to HCN and tartar emetic, and slightly if at all resistant to Thanite (isobornyl thiocyanoacetate).

Beirne (B. P.). **The Nearctic Species of** *Macrosteles* **(Homoptera: Cicadellidae).**—*Canad. Ent.* **84** no. 7 pp. 208–232, 203 figs., 37 refs. Ottawa, 1952.

This revision is based on a study of material representing all but one of the North American species of *Macrosteles* (*sens. lat.*), of which *Davisonia* and *Sonronius* [*R.A.E.*, A **26** 78], as well as *Sagatus*, are considered subgenera. The four subgenera and the 23 species recognised are differentiated in keys, and diagnostic characters are described and illustrated for all the species, their synonyms are shown, and distribution records given. Four of the species are new, four have not previously been recorded from North America, and three include complexes of forms that are morphologically similar but may themselves represent physiological species. The Jassid known as the six-spotted leafhopper, which transmits the virus of aster yellows and has been misidentified as *M. divisus* (Uhl.) [**26** 78], is *M. fascifrons* (Stål), which is recorded from Canada, Alaska and the United States. It is one of the species that comprise complexes of forms, and the characters, identity and distribution of some of those included in it are discussed. The true *M. divisus* has a wide but local distribution in Canada and the United States.

Suter (P.). **Zur Biologie von** *Lecanium corni* **Bché. (Homopt. Coccid.).** [On the Biology of *Eulecanium corni*.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 95–103, 5 figs., 3 refs. Berne, 1950.

Eulecanium (*Lecanium*) *corni* (Bch.) causes considerable injury in some years to grape vine, apricot, plum and ash (*Fraxinus*) in Switzerland, and the honeydew excreted by the Coccids renders fruit unsaleable and encourages infestation by fungi. The crawlers hatch from mid-June and migrate, preferably to the underside of neighbouring leaves. Mortality from various causes in this stage often exceeds 60 per cent. The sexes can be distinguished after the first moult. In August, at the beginning of the second instar, the young Coccids grow but little. Development becomes more rapid towards the beginning of October, and some individuals migrate to the shoots or trunks. Those that remain on the leaves die when the latter fall, and if early frost causes the leaves to be shed by the end of October, mortality from this cause sometimes exceeds 50 per cent. No migration or feeding occurs in the field between December and February, but, when infested plants were removed to a heated room in January, feeding was resumed. Males in a heated room continued development in winter and gave rise to adults at the beginning of February. The females also continued feeding, but almost ceased growth for about four months. The Coccids were able to migrate during the whole of the second instar, which lasted about six months, but did not do so readily. The males moult for the second time 2–3 weeks before the females, and become adult after about another fortnight, at the time when the females are undergoing their second moult. In tests, they did not feed and survived indoors for only 1–2 days. Pairing was not observed in the laboratory, and unfertilised females gave rise to females only [*R.A.E.*, A **21** 554]. The females laid about 1,000 eggs each, and this high fecundity permits sudden outbreaks, though mortality is also sometimes very high. The fungus, *Beauveria* (*Botrytis*) *bassiana*, caused about 95 per cent. mortality of all the species of *Eulecanium* in an area under observation in central Switzerland in 1946 and was still present in 1947–49. Unfavourable weather and birds also give considerable control, and infestation by *E. corni* has remained at a low level in recent years.

Geier (P.) & Baggiolini (M.). **Quelques observations sur la biologie de *Pericerya purchasi* Mask. au Tessin (Homopt. Margaroïd.).**—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 104–116, 1 map, 8 refs. Berne, 1950.

Icerya (*Pericerya*) *purchasi* Mask. was first officially recorded in the Ticino in 1925 [*R.A.E.*, A **14** 118] and now occurs there in various localities in the neighbourhood of Locarno and Lugano, the distribution of which is shown on a map. Observations showed that there are normally two overlapping generations a year, and that all stages are present at the onset of winter. Development and hatching proceeded on fine days in winter, and in some cases five generations were completed within two years. Peaks of infestation occurred between mid-May and the end of June and from the end of July until autumn, these being the periods of reproduction of the two main generations. During the summer of 1949, the first two instars lasted 18–20 and 20–23 days, respectively, the third instar, until the beginning of oviposition, for 10–13 days, and the first eggs laid hatched in 36 days. The oviposition period lasted about 70 days, and up to 812 viable offspring per female were recorded.

Rodolia cardinalis (Muls.) was imported and released several times in 1924–49 against the Coccid and gave valuable biological control during the summer, but proved unable to survive the winter in the open. Since it did not destroy all the eggs in a colony, it neither eradicated the Coccid nor limited its distribution.

Lists are given of the main and subsidiary food-plants of *I. purchasi* in the Ticino. The main ones are *Acacia* spp., *Choisya ternata*, *Citrus* spp., *Genista*, *Juniperus*, *Laurus nobilis*, *Pittosporum*, *Sarothamnus* and *Spartium junceum*. The Coccid is able to establish itself only where these plants are grown and occurs principally in parks and private gardens. The wild vegetation characteristic of the areas in which it occurs is described. Since the Coccid remains extremely localised and is absent from some areas in which ecological factors appear favourable, local differences in climate are considered responsible. It is not known to occur further to the north than the Ticino. Bodenheimer calculated that its threshold of development is 0°C. [32°F.], which would allow a more northerly distribution, but Balachowsky concluded that the annual isotherm of 13°C. [55·4°F.] is its northern limit and consequently that infestation in the Ticino was not permanent. It is considered that the problem might be solved by considerations of microclimate. Insolation is an important factor, and bark temperatures were 9·1–12·4°C. [16·4–22·3°F.] higher than air temperatures at Locarno during a sunny morning in April 1950. The daily periods of sunshine were 1·5–3·1 hours less in an area free from infestation than in an infested area in November–February, and it is concluded that winter sunshine is the main factor regulating distribution.

Martin (Henri). **Note préliminaire sur le comportement de *Ceratitis capitata* Wied. dans la région algéroise. (Dipt. Trypetid.).**—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 120–124, 1 graph. Berne, 1950.

Investigations were made in Algeria from April 1949 to February 1950 on the bionomics and control of *Ceratitis capitata* (Wied.). Adults were present practically throughout the year, but periods of maximum flight occurred in June–July and October–November and activity was low from December to the end of February. *Citrus* fruits, which are the main winter hosts, attracted the adults before they became ripe, whereas apricots and peaches were not attractive until the first fruits were ripening. Females predominated when the fruit was suitable for oviposition, while at other times,

the males were the more numerous. After the last fruits were harvested, the ovipositing females migrated to other host plants, but males and females that had completed oviposition did not. Preference was shown for loquat and apricot in June, peach in June–July, some varieties of fig in July–August, persimmon in October and guava in November. In 1949, *C. capitata* was not much attracted to *Citrus*. The first punctures were observed on orange on 20th September, but larvae were not found in the pulp until October. Eggs and young larvae were found in the pericarp of citron, but none of the larvae entered the pulp. The preoviposition period lasted about 3–6 days in summer, and batches of 1–14 eggs were deposited beneath the epidermis in the pulp of loquats and apricots, and generally at the junction of the mesocarp and exocarp on *Citrus*. Several batches were sometimes deposited in the same cavity. Development was completed in 16–17 days on peach in July–August.

In experiments on control, BHC, which tainted the fruits, and E 605 [parathion] were more rapid in effect but less persistent than DDT. The rapidity of action of BHC increased with temperature, but that of DDT was greatest at 26–30°C. [78·8–86°F.]. DDT was apparently largely repellent in effect. Sprays were superior to dusts, and a spray of wettable DDT remained effective for about a fortnight in summer. The minimum effective concentration was 0·2–0·25 per cent. actual toxicant. In a test in an orange grove at an altitude of about 1,600 ft., the trees were sprayed on 28th September, following a mass appearance of adults, and on 13th and 27th October, with 0·5 per cent. Gesarol (50 per cent. wettable DDT). The adult fruit-flies were practically eliminated from the treated area, and the percentages of fruits found attacked at harvest, on 1st November, were 2·6 on the treated trees and 74 on the controls. In view of the early date of harvest, the third application could well have been omitted.

Fenjves (P.). **Einige Probleme der angewandten Entomologie in Venezuela.** [Some Problems of applied Entomology in Venezuela.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 135–154, 4 figs., 20 refs. Berne, 1950.

The author describes the conditions in which agriculture is carried on in Venezuela, points out with special reference to cotton and sugar-cane that the relation between pests and their food-plants is less stable there than in temperate zones, and gives notes based on the literature and his own observations on the habits and control of some of the more important species concerned.

Leaf-cutting ants identified as *Atta sexdens* (L.), *A. cephalotes* (L.) and *Acromyrmex octospinosus* (Reich) are injurious to almost all the cultivated plants and sometimes endanger buildings by excavating beneath them to construct their nests. Good control was given by a suspension or emulsion spray of 2 per cent. chlordane directed into the exit holes, along runways and round the nests. The treatment should be repeated after two weeks and remains effective for over eight weeks. Young trees can be protected from attack by spraying the trunks and the soil round them twice a year with the suspension. Maize, rice and other crops are seriously attacked by *Laphygma frugiperda* (S. & A.). BHC, DDT, parathion and toxaphene are all toxic to the larvae, and parathion applied as a dust or a liquid to the eggs caused the embryos to die shortly before they were due to hatch. On maize, however, these materials often give only partial control, since the larvae bore into the heart leaves, where they are inaccessible, and treatment checks natural enemies, which are sometimes important on smaller plantings. Maize and sugar-cane are injured by *Diatraea* spp., against which the use of parasites appears promising [*cf. R.A.E.*, A **40** 388, etc.].

Cotton is heavily infested by *Aphis gossypii* Glov., *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) and *Sacadodes pyralis* Dyar, and *Anthonomus grandis* Boh. was recorded on it in Venezuela in 1949, for the first time in South America. *Alabama argillacea* (Hb.), which is widely distributed on *Hibiscus sulfureus*, appears in the cotton fields in April–May and disappears in December–January, after the end of the rains. It is considered that this species migrates to the fields each year from centres that are still unknown but may well be in the interior of the country [*cf.* **17** 709; **29** 404]. Toxaphene sprays or dusts and parathion dusts gave good control of the larvae. *Cosmopolites sordidus* (Germ.) has been present for many years on banana, but infestation was found to be of no importance except in neglected plantations.

Schneider (F.). **Die Entwicklung des Syrphidenparasiten *Diplazon fissorius* Grav. (Hym., Ichneum.) in uni-, oligo- und polyvoltinen Wirten und sein Verhalten bei parasitärer Aktivierung der Diapauselarven durch *Diplazon pectoratorius* Grav.** [The Development of *D. fissorius*, a Parasite of Syrphids, in uni-, oligo- and polyvoltine Hosts and its Behaviour on parasitic Activation of Diapause Larvae by *D. pectoratorius*.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 155–194, 12 figs., 20 refs. Berne, 1950.

Although the species of *Diplazon* that parasitise the larvae of predacious Syrphids are not highly specialised, univoltine and polyvoltine hosts are not normally attacked by the same species, and the ability of the univoltine *D. fissorius* (Grav.), which normally parasitises *Epistrophe bifasciata* (F.) and *Syrphus nitidicollis* Mg., to adapt itself to the oligovoltine *Syrphus ribesii* (L.) and the polyvoltine *E. balteata* (Deg.) was investigated in the laboratory in Switzerland in 1947–49. The following is based mainly on the author's summary of the results of the numerous experiments described.

D. fissorius underwent five larval instars in the host, the first of which was divided into three phases. In the first phase, the larvae did not feed but absorbed protein derivatives through the skin and stored protein in the body. This phase lasted until the host formed its puparium, irrespective of whether the host larva went into diapause or not. Thus the parasite produced the same number of generations as its host. In the second phase, the parasite larvae fed normally and secreted a substance that inhibited moulting, pupation and the further development of the imaginal organs of the host. The third phase was that immediately preceding the first moult. At 20°C. [68°F.], the first four moults were completed in 24–36 hours. The second, third and fourth-instar larvae were rudimentary in form, and those of the fifth of the normal Ichneumonid type. In *S. ribesii*, the larvae began to feed prematurely, probably under the stimulus of the haemogenous defence reaction of the host, but became inactive again when the host entered diapause. In such cases, the period of diapause was abnormally long. In experiments in which the parasites were artificially transferred to new hosts by a technique that is described, eggs of *D. fissorius* developed normally in larvae of *S. ribesii* and *E. bifasciata* in diapause, active first-instar larvae became immobile when transferred to larvae of *E. bifasciata* that were in diapause, and first-instar larvae were activated by transfer to hosts about to pupate.

D. pectoratorius (Grav.) also parasitised *E. bifasciata* and *S. nitidicollis*, but the larvae began to feed immediately after hatching and produced a substance that inhibited development of the imaginal organs of the host. Parasitised larvae formed their puparia prematurely in autumn. From

experiments in which the parasite larvae were confined to one end of the host, in some of which the passage of lymph from one section to the other was prevented, it was shown that formation of the puparium and moulting were induced by secretions from the parasite and that they occurred only after the parasite had moulted. Histolysis took place when the parasite larva was full-grown, after which the latter entered diapause and overwintered. Some larvae of *E. bifasciata* were found in the field that had been parasitised by *D. pectoratorius* and by *D. fissorius*. In this case, both the host and *D. fissorius* were activated by *D. pectoratorius* in autumn. Later, the larva of *D. fissorius* killed its competitor but entered diapause when full-grown, thus again synchronising its life-cycle with that of the host. The nature and function of diapause in Syrphid larvae is discussed.

Vogel (W.). **Untersuchungen über parasitische Hymenopteren der Kirschenfliege.** [Investigations on Hymenopterous Parasites of the Cherry Fruit-fly.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 195–199, 5 figs., 3 refs. Berne, 1950.

The cherry fruit-fly, *Rhagoletis* [*cerasi* (L.)], was attacked by four species of parasites in Switzerland in 1949. Two were rare and were not identified, and the others were the Ichneumonids, *Gelis bremeri* Haberm. and *Phygadeuon wiesmanni* Sachtleben [*cf. R.A.E.*, A **22** 247], the last being the only one numerous enough to give significant control. In laboratory studies at 20°C. [68°F.], the first adults of *P. wiesmanni* emerged at the end of April, about a week after those of *R. cerasi*. The parasites did not oviposit in full-fed larvae, but were observed to investigate puparia, and young larvae were later discovered in some of the latter. At the end of July, 15 per cent. of field-collected puparia were parasitised. These gave rise to parasite adults between 20th August and the end of September, the males appearing first. Pairing occurred shortly after the emergence of the females, and eggs were again deposited in puparia of *R. cerasi*. Puparia each containing one egg were found in the soil at the end of August, and adults of *P. wiesmanni* were taken under cherry trees in several localities in September. Females in the laboratory deposited eggs at the rate of about one per day, and the state of development of the ovaries of newly-emerged examples indicated that the rate in the field is not very high. At room temperatures, the larvae hatched in 4–5 days, became full-fed 3–4 weeks after oviposition, and pupated within the host puparium, the pupal period lasting 10–11 days. It is presumably the second-generation larvae that overwinter in the host puparia in the soil. In the laboratory, most of them gave rise to adults in October, but a third generation was not obtained. The percentage parasitism by both generations combined ranged up to 40–50 in the field. Spraying cherry trees against *R. cerasi* did not harm the parasite, but soil treatment would doubtless have done so.

Wiesmann (R.). **Untersuchungen über die Diapause der Puppe der Kirschfliege** *Rhagoletis cerasi* **L. (Dipt. Trypetid.).** [Investigations on Diapause in the Pupa of *R. cerasi*.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 207–225, 3 graphs, 14 refs. Berne, 1950.

In Switzerland, full-fed larvae of the cherry fruit-fly, *Rhagoletis cerasi* (L.), enter the soil and pupate in late June or July. The pupae develop for 8–14 days, but then enter a diapause that lasts from mid-August at the latest until March or April of the following year. Observations on the factors responsible for breaking the diapause were made in 1935–37, during

investigations on the bionomics and control of *R. cerasi* [*R.A.E.*, A **25** 3, etc.]. Puparia were kept under approximately field conditions in each of the three years, and batches of 100 were transferred each week, beginning in August, to rearing chambers at 22°C. [71·6°F.]. The first pupae to resume development were those brought in late in December, 20 of which gave rise to adults. The percentage of pupae that completed the diapause then rose steadily and reached 100 at the end of March. The periods required for adult emergence at 22°C. were 42–53 days in December, about 30 days in February and 18–20 days in March, and the adults that emerged were normal in every respect. Most of the pupae that failed to resume development in 1936 were still alive in August 1938, when the experiments were suspended. A few of the others gave rise to adults in 1937 or 1938, mostly in summer or autumn, and a few died, apparently as a result of desiccation.

Various methods of accelerating the end of diapause were tested. Subjecting the puparia to temperatures of −2, −4 or −8°C. [28·4, 24·8 or 17·6°F.] for up to 30 days in August–October was ineffective, and exposure to −29°C. [−20·2°F.] for 1–3 days was fatal. When the puparia were kept at 4°C. [39·2°F.] from early August and batches were transferred at weekly or monthly intervals to 22°C., development was resumed in the batches transferred from October onwards, the percentage rising from less than 10 in early October to about 60 in early December and 100 in February. The development period after mid-February was about 20 days. Development was not resumed when the puparia were left at 4°C. When the puparia were kept at 10–12°C. [50–53·6°F.] before being transferred, not more than 32 per cent. completed the diapause, and the earliest date of emergence was not advanced. It is considered that these temperatures are the upper limit at which diapause can be completed. Immersing the puparia in chemical solutions or hot water, exposing them to vapours and other shock treatments had little or no effect on the course of the diapause.

The results obtained are discussed in relation to theories as to the cause of diapause in insects. Roubaud considered that diapause was due to uric-acid intoxication [*cf.* B **11** 55], but no uric acid could be found in pupae of *R. cerasi* that had just entered diapause. The results were not in conflict with the views of C. M. Williams, however, who considers that diapause in Lepidopterous larvae is due to an interruption of hormone-formation by the endocrine glands and its cessation to a resumption of this activity.

Kern (F.) & Günthart (E.). **Weitere Untersuchungen über den Flug des Maikäfers** (*Melolontha vulgaris* **F.**). [Further Investigations on the Flight of *M. melolontha*.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 226–232, 3 graphs. Berne, 1950.

Observations were made in the canton of Basle in 1950 on the emergence and flight of adults of *Melolontha melolontha* (L.) (*vulgaris* F.) and the meteorological conditions during the flight period. Two emergence cages each covering a little over two square yards of soil were set out. One of them was left permanently on the same site, but the other was moved each day, the area covered on the previous day being dug up and the numbers of males and females that had emerged compared with the numbers remaining in the soil. It was thus possible to forecast the intensity of the next flight, and the data served to supplement the information obtained from the sex ratio of the beetles on the trees [*cf. R.A.E.*, A **40** 188].

Because of cold weather at the end of April, trees were backward in development and adult emergence extended over a fortnight. Peaks of

flight were observed on 30th April and 1st May and on 6th, 8th–9th and 10th–12th May. Up to 25 per cent. of the adults in the soil, particularly those at a depth of about 4 ins., were killed by a fungous disease. Those that emerged usually flew northwards to woodland, but on three evenings they almost all flew westwards to a rather more distant forest edge. On these three evenings, dark cloud was over the woods to the north, whereas the sky to the west was clear and bright. It is concluded that the adults flew to the horizon offering the greatest contrast. It was confirmed that males emerged before females, but the ratio of females to males in early May was considerably higher on stone-fruit trees, particularly cherry and plum, than on trees at the forest edge. It therefore appeared that the females began to wander soon after the original flight, and this was confirmed by the more advanced state of development of the ovaries of females taken on the fruit trees. It is concluded that the results obtained by collecting the beetles from stone fruits are not representative of the population as a whole and should not be used alone for timing control measures.

HORBER (E.). **Beitrag zur Biologie und Bekämpfung des Speisebohnenkäfers** *Acanthoscelides obtectus* **Say (Col. Bruchid.).** [Contribution to the Bionomics and Control of *Bruchus obtectus*.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 233–244, 4 figs., 12 refs. Berne, 1950.

Increased damage to beans in store in Switzerland by *Bruchus (Acanthoscelides) obtectus* Say was found in 1947–49 to be due not only to the greater quantities stored, but also to field infestation [*cf. R.A.E.*, A **40** 398, etc.], and in 1949, beans infested in the field were received from the cantons of Geneva, Zürich and Aargau. Early-maturing varieties were more heavily infested than late ones. The control of the Bruchid in stored beans is reviewed from the literature. In a test, very good results were given by treatment with a BHC smoke, which was more effective and less expensive than a DDT dust and did not affect the germination of seed beans. Two tests were also carried out to investigate the possibility of adding insecticides to the sprays normally applied to the crop against diseases. Two applications of suspension sprays were made a fortnight apart in August, and the percentage of beans infested was reduced from 4·4 to 2·5 by 0·02 per cent. parathion, 0·4 by 0·1 per cent. DDT, 0·1 by 0·1 per cent. BHC and 0·7 by 0·05 per cent. DDT with 0·01 per cent. parathion on one early variety in pod, but inferior results were given on another and on a late variety.

GÜNTHART (E.). **Hexa- und Chlordan-Präparate zur Bekämpfung von Wurzelschädlingen.** [BHC and Chlordane Preparations for the Control of Root Pests.]—*Mitt. schweiz. ent. Ges.* **23** pt. 2 pp. 245–264, 5 figs., 50 refs. Berne, 1950.

Investigations on the control of soil pests in Switzerland by BHC and chlordane were begun in 1944 and 1947, respectively, and the results of tests in which these materials, sometimes in comparison with others, were applied to the soil or otherwise against various insects are summarised as a basis for recommendations. The rates which follow refer to the quantity of γ BHC or technical chlordane applied per acre. First- or second-instar larvae of *Melolontha melolontha* (L.) in beet fields, summer wheat or pasture can be controlled by soil treatment with BHC or chlordane in dusts or liquids at 1·125–2·25 and 4·5–9 lb., respectively, and wireworms, mostly *Agriotes* spp., on cereals, peas, potatoes and sugar beet by the same materials in dusts at 0·675–1·125 and 4·5 lb. Watering the soil round the

plants with an emulsion of chlordane at 2·7 lb. and spraying four times during the oviposition period with chlordane at 3·6 lb. are recommended against *Psila rosae* (F.) and *Phytomyza lateralis* Fall., respectively, on carrot. Bean seeds should be moistened with water and dressed with 0·032 per cent. by weight of BHC before sowing and an emulsion of chlordane at 2·7 lb. poured round newly-planted onion seedlings to prevent damage by larvae of *Hylemyia cilicrura* (Rond.) and *H. trichodactyla* (Rond.), and the soil watered with chlordane emulsion at 4·5 lb. against larvae of *H. brassicae* (Bch.) on cauliflower and of *Agrotis* spp. on cauliflower, lettuce and tobacco.

Görnitz (K.). **Die Massenaufzucht von Raupen der Wintersaateule (*Agrotis segetum* Schiff.) für Laboratoriumsversuche.** [Mass Rearing of Larvae of *A. segetum* for Laboratory Experiments.]—*Anz. Schädlingsk.* **24** pt. 5 pp. 65–68, 2 figs., 6 refs. Berlin, 1951.

A technique is described by which *Agrotis segetum* (Schiff.) is reared in the laboratory in Germany to provide material for tests of insecticides. Newly emerged adults are released in glass cylinders measuring about 8 ins. in diameter and 12 ins. in height, covered with gauze and containing leafy shoots for oviposition. The leaves bearing eggs, and any larvae that hatch from eggs laid elsewhere in the cylinders, are removed at regular intervals to glass dishes containing a ¾ in. layer of damp sawdust on which leaves or other food materials are placed. Covers are necessary to prevent young larvae from escaping, but not for older ones, which cannot climb the vertical sides of the dishes. Blotting paper is placed beneath the covers to prevent condensation. The contents of the dishes are passed through a sieve each week, pupae removed and the larvae replaced on fresh sawdust. The leaves of many plants, particularly crucifers, and root vegetables, potato tubers and vegetable peelings proved suitable as food.

Observations made on the bionomics of *A. segetum* in the course of the work were not all in accordance with Fiedler's results [*R.A.E.*, A **29** 449]. The egg stage lasted five days at 24°C. [75·2°F.] and 15–16 days at 14·6°C. [58·28°F.] (the threshold of development as calculated by Fiedler), and the threshold of development was found to be 10·1°C. [50·18°F.]. The adults lived for 10–23 days, and females oviposited from the fourth day after emergence. The maximum number of eggs per female was 1,514. At 24°C., at which development was shortest, the first four larval instars lasted 4, 4, 6 and 6 days, respectively, the fifth instar and prepupal stage together 11 days, and the pupal stage 14–16 days for males and 15–18 days for females. Few larvae underwent a diapause. There was a tendency to cannibalism among the older larvae, but losses were not significant when humidity was adequate. Considerable mortality was caused at times by a bacterial disease, against which prophylactic measures proved ineffective, and it was necessary to restock at intervals with fresh material from the field.

Roesler (R.). **Schädliches Auftreten von Spinnmilben an Obstbäumen in der Pfalz (Tetranychidae, Acar.).** [The injurious Occurrence of Tetranychid Mites on Fruit Trees in the Palatinate.]—*Anz. Schädlingsk.* **24** pt. 5 p. 68, 12 refs. Berlin, 1951.

Tetranychid mites increased considerably on fruit trees in the Palatinate during dry summers prior to 1951 and caused severe injury in some localities. The species identified comprise *Paratetranychus pilosus* (C. & F.) on apple

and plum, *Bryobia praetiosa* Koch on apple, peach and pear, and *Tetranychus crataegi* Hirst on apple. The last two have not previously been recorded on fruit trees in that area. Large colonies of *B. praetiosa* were found in the summer of 1950. Adult females and eggs were observed on twigs of peach and pear in July. The females died after a short time, and the eggs overwintered. In other places, females were numerous on the leaves of apple in the second half of August, sometimes occurring together with *P. pilosus*, and it was not known whether these belonged to a late first or to a second generation. The examples of *T. crataegi* were taken in trap bands on the trees in October and November 1950, together with an unidentified species of *Tetranychus* that occurs on apple every year and is sometimes very numerous.

Weber (G.). **Ein Beitrag zur Bekämpfung der Kirschfliege** (*Rhagoletis cerasi*). [A Contribution to the Control of *R. cerasi*.]—*Anz. Schädlingsk.* **24** pt. 5 pp. 69–70, 2 figs., 2 refs. Berlin, 1951.

The experiment described was carried out in a locality in south-western Germany in which infestation of cherries, particularly late varieties, by *Rhagoletis cerasi* (L.) was heavy and the effect of cultural control measures negatived by reinfestation from neighbouring wild cherry trees. Puparia in containers placed in selected sites under the trees in mid-May gave rise to adults on 30th May, and sprays of 0·2 or 0·33 per cent. Gesarol 50 [containing 50 per cent. DDT] or 0·075 per cent. E 605 forte [an emulsion concentrate containing 50 per cent. parathion] were applied on 5th June. It was intended to repeat the treatment on the late varieties ten days later, but bad weather prevented this. The percentages of fruits infested on 25th–26th June, before the harvest of the medium–early varieties had ended or that of the late ones begun, were 3·8, 2·2 and 12 for the three treatments, respectively, and 36·1 in the controls. The difference between the percentages for the two concentrations of DDT was not statistically significant. The effectiveness of the single treatment was partly due to the weather, which permitted the spray residues to remain on the trees for ten days after treatment and then became unfavourable for the flight of the adults, but partly also to correct timing, the emergence data obtained proving very accurate.

Mutz (H.). **Über das Auftreten des Dickmaulrüsslers** *Otiorrhynchus ovatus* **L. als Schädling der Erdbeeren** (*Fragaria*). [On the Occurrence of *O. ovatus* as a Pest of Strawberries.]—*Anz. Schädlingsk.* **24** pt. 5 pp. 70–74, 5 figs., 20 refs. Berlin, 1951.

Otiorrhynchus ovatus (L.) is not normally injurious to strawberries in Germany but caused serious damage in large plantings at Strehla in Saxony, in 1946 and again in 1949, when crop losses amounted to 75–100 per cent. and 20 per cent. of the beds were completely destroyed. The damage to the plants is described, the bionomics of the weevil in the United States, where there is one generation a year [*cf. R.A.E.*, A **16** 23], and in Europe, where development lasts for up to three years [*cf.* **12** 98], are briefly reviewed from the literature, and short descriptions are given of the larva, pupa and adult. The injury to strawberries was almost entirely confined to plants three years old. The larvae fed on the roots and were particularly injurious between the middle and end of May, just before they pupated, when up to 15–20 per plant were found. In mid-June, full-fed larvae

represented about 15 per cent. of the population, pupae 70 per cent. and newly emerged adults 15 per cent. The recurrence of the outbreak in 1949 suggested a three-year cycle of development. The areas attacked in the two years were adjacent to each other and surrounded by paths. It is assumed that the adults, which are wingless, overwintered in the weeds on the path and migrated to the beds for oviposition. Deep ploughing and rolling infested plots before the first adults appear are recommended for control, and trap pits and trenches to prevent migration to fresh plantings.

GODAN (D.). **Über Nahrungs- und Brutpflanzen des Rapserdflohs (*Psylliodes chrysocephala* L.).** [Concerning the Plants on which *P. chrysocephala* feeds and breeds.]—*Anz. Schädlingsk.* **24** pt. 6 pp. 81–84, 22 refs. Berlin, 1951.

Psylliodes chrysocephala (L.) is a serious pest of turnip rape and to a less extent of rape in Germany and also attacks other cultivated and wild crucifers. In investigations on the way in which it survives the periods between crops, carried out in August and September of 1948 and 1949 on the island of Poel, off the Baltic coast, adults that had been starved for three days did not feed on grasses or fresh leaves of non-cruciferous plants of 12 genera found growing near the place where the flea-beetles were taken, and other examples survived at room temperature for up to 39 days without food or water and for up to 56 days with water only. A list is given from the literature of the wild and cultivated crucifers infested by the larvae, and the significance of the former in maintaining the species is discussed [*cf. R.A.E.*, A **30** 208]. In tests, the larvae did not develop beyond the second instar on mustard (*Sinapis alba*) or *Thlaspi arvense*, both of which are rich in mustard oil. Differences in infestation by the larvae of rape and turnip rape sown at different seasons, and their causes, are discussed from the literature. They are explained by the preference of the adults for turnip rape if available and for young plants in the presence of rape alone, and by the fact that eggs deposited in September do not hatch until the following spring.

HAINE (E.). **Zur Frage der Überwinterung von *Myzodes persicae* Sulz. an Sekundärwirten: II. *Myzodes persicae* Sulz. und andere an Kartoffeln vorkommende Aphiden in den Gewächshäusern von Bonn.** [Contributions to the Question of the Overwintering of *Myzus persicae* on secondary Hosts: II. *M. persicae* and other Potato Aphids in the Glasshouses of Bonn.]—*Anz. Schädlingsk.* **24** pts. 7–8 pp. 97–103, 120–122, 30 refs. Berlin, 1951.

The following is based largely on the author's summary. The investigations on *Myzus (Myzodes) persicae* (Sulz.) overwintering anholocyclically in the field near Bonn [*R.A.E.*, A **41** 184] were supplemented by counts of Aphids on plants of 227 species and varieties in glasshouses near the city in January-March 1947, July-August and December 1948 and March 1949. The presence of other Aphids that commonly infest potato was also noted. The results are given in tables and discussed, and the virus diseases that each Aphid is known to transmit are reviewed from the literature. The Aphids found and (in brackets) the numbers of plant species and varieties on which they were observed were *M. persicae* (49), *M. (Neomyzus) circumflexus* Buckt. (38), *Macrosiphum solani* (Kalt.) (*Aulacorthum pseudosolani* (Theo.)) (34), *M. solanifolii* (Ashm.) (12), *Myzus ornatus* Laing (6), *Aphis*

gossypii Glov. (*Doralis frangulae*, auct.) (12) and *A.* (*D.*) *fabae* Scop. (5). All except *M. ornatus* were present during each period of inspection, and it is therefore concluded that development of *M. persicae*, *M. circumflexus*, *Macrosiphum solanifolii*, *Aphis gossypii* and *A. fabae* in the glasshouses was anholocyclic. In general, alates were rare. Insecticides containing parathion, BHC or DDT were used in the glasshouses from 1948 onwards. Parathion sprays at rather high concentrations and a BHC smoke gave satisfactory control of the Aphids when applied at intervals of 8–14 days, but DDT did not give high mortality. A parathion spray proved very effective against *Myzus persicae*, *M. circumflexus*, *Macrosiphum solanifolii* and *M. solani* on potato in the laboratory.

Grison (P.) & Viel (G.). **Les traitements aériens contre le doryphore. Premières remarques sur les études faites à Caen en 1949.**—*Bull. tech. Inform. Ing. Serv. agric.* no. 46 repr. 7 pp., 8 figs. Paris, 1950.

In the experiments described, which were carried out in the district of Caen in 1949, attempts were made by means of DDT applied from helicopters or an aeroplane to destroy the adults of the Colorado beetle [*Leptinotarsa decemlineata* (Say)] as soon as they appeared in spring and before they dispersed by flight to potato in other areas. It is pointed out that such treatments should be timed according to the emergence period of the insects in the region, but that the theoretical date, calculated from average conditions, may differ from the date actually most favourable in any given year. In May 1949, temperatures were abnormally low at Caen, resulting in retarded infestation by the spring adults, and it was estimated that the most favourable period for treatment would be between 6th and 18th–23rd June. The treatments comprised an emulsified solution of DDT in xylene sprayed from a helicopter at a rate of about 1 lb. DDT per acre and dusts of 4·5 or 5 per cent. DDT applied by helicopter or aeroplane. The amounts of DDT recovered from the plants averaged about 7 oz. per acre for the spray and about 2·5–6·5 and nearly 2 oz. per acre for the dusts applied by helicopter and aeroplane, respectively. In all cases, the DDT reached the lower surfaces of the leaves.

Counts on plants artificially infested with adults and larvae before treatment showed that the three methods of application were about equal in immediate effect; the spray, which gave the most even distribution of poison, killed averages of 60 per cent. of the adults and 90–99 per cent. of the larvae in four days. Statistical analysis of field populations showed that a single application of the 5 per cent. dust by aeroplane on 2nd June, followed by two days of heavy rain, was effective for less than six days, after which infestation soon reached its former level, whereas one of the spray on 11th June reduced the adult population by 75 per cent. and kept it at that level for three weeks. Although there had been much oviposition before this latter treatment, larvae were rare until the end of June; oviposition increased after 25th June, and larvae were abundant in July. Artificial infestation of plants at intervals after treatment showed that the 4·5 per cent. dust, applied by aeroplane, gave no protection after eight days, whereas the 5 per cent. dust, applied by helicopter, was still half as effective as at first after 15 days and the spray gave 40 per cent. kill of the adults and 90 per cent. kill of the larvae after three weeks.

It is concluded that none of the treatments gave sufficient mortality of spring adults to avoid the necessity for subsequent control measures against the first-generation larvae, and that the high cost of this method makes it uneconomic except for the purpose of protecting uninfested territory.

Blunck (H.). Ed. **Tierische Schädlinge an Nutzpflanzen. 2. Teil.** [Animal Pests of Economic Plants. Part 2.]—Sorauer (P.). *Handb. Pflanzenkr.* **5,** 5.Aufl., 1.Lief., viii + 311 pp., 95 figs., many refs. Berlin, P. Parey, 1953. Price *DM.* 80.

This is the first part of the much enlarged fifth edition of the fifth volume of Sorauer's textbook [*cf. R.A.E.*, A **38** 300; **41** 221], and contains the sections on Diptera (pp. 1–166) and Hymenoptera (pp. 166–288).

Baeta Neves (C. M.). **Introdução à entomologia florestal portuguesa.** [An Introduction to Portuguese Forest Entomology.]—*Terra e o Homem* **18** xi + 225 [+2] pp., 82 figs., 4½ pp. refs. Lisbon, Livr. Sá da Costa, 1950.

The most important indigenous forest trees of Portugal are *Pinus pinaster*, *Quercus suber* (cork oak) and *Q. ilex*. The first part of this book comprises accounts of the conditions under which these trees occur, the habits of their principal insect pests, and the damage caused by them. Scolytids and Platypodids on *P. pinaster*, *Lymantria dispar* (L.) on *Q. suber* and *Tortrix viridana* (L.) on both species of *Quercus* are dealt with at greatest length, much information being given on their bionomics and some on the control of the last two. The second part deals with the prevention of infestation, and its scope is extended to include not only the main indigenous forest trees but also introduced species and fruit trees.

Bowen (H. D.), Hebblethwaite (P.) & Carleton (W. M.). **Application of Electrostatic Charging to the Deposition of Insecticides and Fungicides on Plant Surfaces.**—*Agric. Engng* **33** no. 6 pp. 347–350, 8 figs., 4 refs. Saint Joseph, Mich., 1952.

Recent tests of the deposition of dusts in the field showed that only some 10 per cent. of the dust discharged was actually deposited on the plants, so that under normal agricultural conditions the amount will seldom exceed 15–20 per cent., even on dense foliage. Many attempts have been made to use the electrostatic charges on dust particles to improve deposition, but field results have been unsatisfactory, and the charging procedure used has proved undependable. The authors give a simplified theory of the attraction of charged dust to a growing plant [*cf. R.A.E.*, A **36** 393, etc.] and discuss the combined effects of the forces resulting from the electric charge and the dynamic forces involved in the dusting process itself. For optimum results, the particles must be individually charged to a high value and all of the same electrical sign, as otherwise the field intensity due to the cloud will be less than the maximum and many of the particles will neutralise each other before they can be deposited on the plant. Friction charging, such as was used by earlier workers and occurs in ordinary dusting [*cf. loc. cit.*] yields charges of both signs in the same cloud when different materials are mixed, does not always occur at high relative humidities and gives variable results throughout an average day.

A method of charging dust by means of an ionised electric field is described. It involves the use of a charging nozzle consisting of an earthed metal cylinder having a wire needle down its centre and insulated from it. The needle is maintained at a very high negative potential and produces a corona discharge, within which air molecules are ionised. The negative ions are attracted to the cylinder wall, and when a dust is blown through the cylinder, become attached to the particles; they are so numerous that very

large charges are rapidly built up. The maximum charge possible on a particle depends on the strength of the field and the size of the particle, and the particle must remain in the nozzle long enough to pick up a useful charge but not long enough to be driven to the wall by the force of the electric field.

In laboratory tests in which small metal plates were dusted with uncharged and charged dusts at relative humidities varying from 40 to 100 per cent., deposits were significantly higher from charged than from uncharged dusts at all humidities, though the differences were much greater at the lower humidities. At constant humidity, variation in temperature appeared to have little effect on the deposition of charged dust. Dust particles still bore electric charges when 33 ft. from the nozzle (20 seconds after leaving it), and the charge was still sufficient to give a significantly better deposit than that from uncharged dust that had travelled the same distance. A series of tests showed that there is a relation between the current used to charge the needle and the amount of dust deposited and that the optimum current varied with the nature of the dust and to some extent with atmospheric conditions.

For field tests, a dusting machine of conventional design with eight outlets was adapted for use with the electrostatic unit. A 6-volt car battery was used as the source of the current, and the needle was charged at 12,000 volts. This appeared to be rather too high for optimum results, but there was a real advantage from charging the dust, and no difficulty was found in dusting satisfactorily at 100 per cent. relative humidity. In 1951, the charged dust resulted in significantly higher yields than uncharged dust in several plots of potato and onion, particularly where application levels were low, and more dust was visible on plant leaves treated with charged than with uncharged dust. Measurements on dusted bean leaves showed that about 23 and 10 per cent., respectively, of charged and uncharged lead-arsenate dust was deposited and that about 7 and 4 per cent. remained 16 days later after one inch of rain had fallen.

It is concluded that electrostatic charging results in a considerable saving in the quantity of dust required and in more even coverage of the plant surface. It may reduce susceptibility to weather conditions and eliminate the need for night dusting. The method could be applied to insecticidal fogs, aerosols, smokes and sprays, though there would be considerable problems of insulation in the case of aqueous sprays.

Autuori (M.). **" M.M.33 ", um novo formicida a base de brometo de metila no combate à formiga saúva (*Atta* spp.).** [M.M.33, a new Formicide containing Methyl Bromide for the Control of Leaf-cutting Ants (*Atta* spp.).]—*Biológico* **16** no. 9 pp. 175–180. São Paulo, 1950.

In view of the promising results given by fumigation with methyl bromide against leaf-cutting ants of the genus *Atta* in São Paulo [*cf. R.A.E.*, A **41** 220, etc.], tests were made in July 1950 with a liquid referred to as M.M.33. This is stated to consist of methyl bromide in a mixture of benzene and carbon bisulphide, the proportions not being given, with the addition of 10 per cent. trichlorobenzene. The vapours from the solvents add to the fumigant effect of the bromide, and the trichlorobenzene, which acts as a fumigant and fungicide and vaporises slowly, confers long-lasting toxicity. The liquid was applied at 10 or 15 cc. per sq. metre with a funnel and a length of rubber tubing through openings in the nest so selected that there was one in each 5 or 10 sq. m. of nest surface. The nests were inspected after three days, and only six of the 71 treated showed any ant activity.

After 30 days, there was no activity in any of the nests treated through one hole per 10 sq. m., but mortality was not complete in one nest in each of the series treated through one hole per 5 sq. m. After 60 days, mortality was complete in these also.

[Gaprindashvili (N. K.) & Novitzkaya (T. N.).] Гаприндашвили (Н. К.) и Новицкая (Т. Н.). **Contribution to the Question of the Study of the Action of organophosphorus Preparations on the Natural Enemies of Pests of subtropical Plants in the Georgian SSR.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **17** no. 12 pp. 11–15, 6 refs. Moscow, 1952.

The two organophosphorus preparations tested in the experiments described, which were carried out in the Republic of Georgia in 1951–52, were thiophos (parathion) in the form of a 1 per cent. dust and a 50 per cent. spray concentrate, and pyrophos, in the form of a spray concentrate containing 25 per cent. unspecified active ingredient [? tetraethyl pyrophosphate], and the natural enemies comprised both predators and parasites.

The predators were the Coccinellids, *Cryptolaemus montrouzieri* Muls., which attacks various mealybugs, *Rodolia cardinalis* (Muls.), which attacks *Icerya purchasi* Mask., *Lindorus lophanthae* (Blaisd.), which attacks Diaspine scales, *Chilocorus renipustulatus* (Scriba), *C. bipustulatus* (L.), and *Exochomus quadripustulatus* (L.), which attack various Coccids, and *Stethorus* (*Pullus*) *punctillum* Weise, which is predacious on phytophagous mites. The parathion dust undiluted and the parathion concentrate diluted to 0·2–0·3 per cent. caused complete or almost complete kill of larvae and adults of all the Coccinellids in laboratory tests on potted *Citrus* trees infested by Coccids and mites, but mortality of adults in *Citrus* plantations was somewhat lower as individuals protected from the dust or spray were not affected. The concentrate applied in the laboratory at 0·05 or 0·1 per cent. killed all larvae in the first three instars, 70–100 per cent. of those in the fourth instar, and 30–90 per cent. of the adults. Eggs and pupae were little affected in any of the tests, but adults that emerged and larvae that hatched within three days after treatment in the laboratory and within one day of it in the field were killed. The pyrophos concentrate was tested at 0·05–0·3 per cent. in the laboratory, and in general resembled parathion in its effects.

In tests on the duration of toxicity to the Coccinellids, palms and oleanders in the laboratory and *Citrus* trees in the field were treated with the parathion dust or 0·2 per cent. of the spray concentrate, and larvae and adults, and in some cases pupae, were placed on them immediately or after 1–3 days. Mortality was complete among those released immediately, high in the laboratory but low in the field after one day, and negligible after two or three days except for *Stethorus*. Dusting was more harmful in most cases than spraying, and migration from untreated trees in the field began after two days to sprayed trees but not until after 3–4 to the dusted ones.

The parasites tested were *Coccophagus lycimnia* (Wlk.) (*lecanii* (Fitch)), *C. scutellaris* (Dalm.) (*lunulatus* How.) and *Eucomys swederi* (Dalm.), which attack soft scales. When palms in glasshouses were treated with the parathion dust or the concentrate at 0·2–0·3 per cent., the adults of all these parasites were killed, but adults that emerged 2–3 days after treatment were not affected.

It is concluded that phosphorus compounds are initially more toxic to natural enemies than other insecticides, and as they do not kill the eggs of Coccids or mites, these pests may show a sudden increase 15–20 days

after treatment. If this occurs, supplementary releases of the parasites should be made.

[Grigor'eva (T. G.).] Григорьева (Т. Г.). **The Action of Hexachlorane introduced into the Soil on the Soil Fauna.** [*In Russian.*]—*Dokl. vsesoyuz. Akad. sel.-khoz. Nauk Lenina* **17** no. 12 pp. 16–20, 1 graph, 7 refs. Moscow, 1952.

Details are given of investigations in the Province of Leningrad in 1948–50 on the effects of soil treatment with BHC on the general soil fauna and on insects on the soil surface. Examination of soil samples three months after treatment showed that phytophagous and predacious species were very susceptible to BHC, mortality among them increasing progressively as the rate of application rose from 4·5 to 27 lb. per acre. Saprophagous species, however, increased with low dosages of BHC and showed considerable reductions only with dosages of 13·5 and 27 lb. per acre. Rates of 9–13·5 lb. per acre, which are recommended for use against wireworms in podzol soils, had no detrimental effect on earthworms and small Oligochaetes.

There was an increase in the total soil fauna during the second and third years after treatment at 13·5–40·5 lb. per acre, as compared with the controls, and a reduction in the third year following treatment at the excessively high rate of 67·5 lb. per acre. There was a general reduction of wireworms in all three years. Of the surface fauna, adult Carabids were adversely affected during the first year after treatment at 4·5–27 lb. per acre, but not during the second or third, and examination of wheat growing on the treated plots during the first year showed that the percentage infestation by *Oscinella frit* (L.) decreased from 3·8 to 0·9 as the dosage of BHC rose from 4·5 to 27 lb. per acre, as compared with 4·9 for no treatment. It was not known whether this result was due to systemic action [*cf. R.A.E.*, A **41** 101] or to a repellent effect on the ovipositing adults.

Papers noticed by Title only

Lord (K. A.), Ward (J.), Cornelius (J. A.) & Jarvis (M. W.). **Chromatographic Separation of the Pyrethrins.**—*J. Sci. Fd Agric.* **3** no. 9 pp. 419–426, 1 fig., 3 graphs, 14 refs. London, 1952.

Thomas (A. M.). **Pest Control by High Frequency Electric Fields—Critical Résumé.**—*Tech. Rep. elect. Res. Ass.* no. W/T23, 40 pp., 14 figs., 159 refs. Leatherhead, Surrey, Elect. Res. Ass., 1952. Price 24*s*.

Short (J. R. T.). **A Grouping by larval Characters of some Species of the Genus *Apanteles* (Hymenoptera: Braconidae).**—*Bull. ent. Res.* **44** pt. 2 pp. 327–332, 4 figs., 9 refs. London, 1953.

Ferris (G. F.). **Atlas of the Scale Insects of North America. Volume VI. The Pseudococcidae (Part II).**—11 × 8½ ins., pp. vii + 279–506, 85 figs., planographed. Stanford Univ. Pr., Calif.; London, G. Cumberlege, Oxford Univ. Pr., 1953. Price $7.50. [*Cf. R.A.E.*, A **25** 595; **39** 140, etc.]

Linssen (E. F.). **Entomological Photography in Practice. A Guide Book for Photographers and Naturalists on the photographic Illustration of close-up Natural History Subjects.**—8¾ × 6½ ins., 112 pp., 12 pls., 7 figs. London, Fountain Pr., 1953. Price £1 12*s*. 6*d*.

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